Referral systems and transport for emergency obstetric care in India

DR. SAMIKSHA SINGH

Thesis submitted in accordance with the requirements for the degree of

Doctor of Philosophy
University of London

2018

Department of Non-communicable Diseases

Faculty of Epidemiology and Population Health

LONDON SCHOOL OF HYGIENE & TROPICAL MEDICINE

Funded by Wellcome Trust Capacity Strengthening Strategic Award to
the Public Health Foundation of India and a Consortium of UK Universities

DECLARATION OF OWN WORK

I, DR. SAMIKSHA SINGH, confirm that the work presented in this thesis titled '*Referral systems and transport for emergency obstetric care in India*' is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Two researchers helped me in systematic reviews for selection of studies to be included for analysis. Two researches helped me in the conduct of telephone interviews and interviews of a few nurses where I had a language barrier. The interviews were directly supervised and all other aspects in thesis were managed by me. All other work of planning, conducting, analysing and reporting of this research is done by me.

DR. SAMIKSHA SINGH March 2018

ABSTRACT

Background

Institutional delivery rates in India have improved in the past decade, but maternal mortality remains high. The aim of this study was to describe current referral pathways and transport services for pregnant women in the Indian public health sector to identify strategies for strengthening the referral system for emergency obstetric care.

Methods

I conducted three literature reviews; a health provider's KAP survey of staff in primary level public health facilities from two states; analyses of '108' ambulance service data from six states; and telephone interviews of women who called this service in two states.

Results

The reviews found no standard protocols or guidelines for referral of women with obstetric high-risk or complications in India, and over half of pregnant women attending primary level health facilities were referred. There was poor quality institution referral care and no studies on the effectiveness of transport interventions.

The KAP study found staff had sub-optimal knowledge and practice for screening common high-risk conditions and complications, and low confidence and resources to manage emergency situations.

Less than a quarter of pregnancies and institutional deliveries in the study populations used '108' ambulances. Most women called the service for normal labour: only 4.3% had an obstetric emergency and 5.8% were inter-facility transfers. Of pregnant callers to the '108' service, one third reported a high-risk condition or early complication in pregnancy. Women transported using other means were more likely to use private facilities than those transported by '108'.

Conclusion

The quality of obstetric care at peripheral health centres is suboptimal and the high proportion of referrals could be avoided. The '108' ambulance service is underused, especially in emergency situations. India's health systems should improve the provision of obstetric care by standardising services at each level of health care. Strategies are required to increase the use of '108' services for obstetric emergencies.

ACKNOWLEDGEMENTS

I take this opportunity to convey my sincere gratitude and appreciation to all those who made this PhD thesis possible.

I offer my regards and sincere gratitude to my supervisor Prof. Pat Doyle for her unparalleled and indispensable supervision, guidance, support, inspiration and encouragement. Her patient mentoring, constructive suggestions and focus on quality has helped me learn during every phase of producing this work. I thank her for always being there for me.

I express my gratitude to my co-supervisor Prof. Oona M Campbell for her unflinching support and advice, and sharing her extensive expertise. Her motivation and useful insights have helped me plan, execute and interpret my work better. I feel privileged to be associated with her.

I am grateful to Prof. GVS Murthy for his patience and guidance whilst allowing me the room to work in my own way. His support helped me through the most difficult phases of my work.

My thanks are due to my advisor Ms. Laura Oakley who helped me in dealing with missing data. She helped me in statistical analysis and interpretation of a difficult part of my work.

I am grateful to GVK-EMRI and Dr. GV Ramana Rao for providing access to their data and other arrangements, and allowing analytical freedom.

I thank the reviewers who helped me in selection of studies for systematic reviews- Manu Mathew and Pranav Bhushan; and those who helped in data collection where language barriers existed: Mr. SK Ezas, Mr. Mohammad Hamid Ali and Ms. Pratiksha Singh.

I must thank all my colleagues and administrative staff at the IIPH–Hyderabad for all their support and suggestions during this journey.

I thank the Wellcome Trust Capacity Strengthening Strategic Award to the Public Health Foundation of India and a consortium of UK universities that funded my PhD work.

Lastly, my special regards and heartfelt gratitude to my parents, siblings and friends for their infallible love and support. Their love helped me trust myself and complete my work.

Dr. Samiksha Singh

ABBREVIATIONS

AHS	Annual Health Survey
ANC	Antenatal care
ANM	Auxillary Nurse Midwife
AP	Andhra Pradesh
ASHA	Accredited Social Health Activist
AWW	Anganwadi Worker
BEmOC	Basic Emergency Obstetric Care
CEmOC	Comprehensive Emergency Obstetric Care
CHC	Community Health Centre
DLHS	District Level Household Survey
EmOC	Emergency Obstetric Care
EMT	Emergency technician
GVK-EMRI	GVK- Emergency Medicine Research Institute
HP	Himachal Pradesh
IFT	Inter-facility Transfer
INR	Indian Rupee
JEY	Janani Express Yojana
JSSK	Janani Shishu Suraksha Karyakaram
JSY	Janani Suraksha Yojana
LMIC	Low-middle income country
MDG	Millennium Development Goal
MMR	Maternal Mortality Ratio
MPHW	Multi-purpose Health Worker
Non-IFT	Non inter-facility transfer
NFHS	National Family Health Survey
NHM	National Health Mission
NRHM	National Rural Health Mission
PHC	Primary Health Centre
PNMR	Perinatal Mortality Ratio
RCH	Reproductive and Child Health
RMNCH+A	Reproductive Maternal Neonatal and Child Health + Adolescents
SBA	Skilled Birth Attendant
SDG	Sustainable Development Goal
SHC	Sub-health Centre
SRS	Sample Registration System

TABLE OF CONTENTS

List of Figures

List of Tables

LONG ABSTRACT

Background

India has achieved considerable improvement in institutional delivery rates in the past decade, but maternal mortality remains high due to poor quality care and inadequacy of referrals for obstetric emergencies. There is an urgent need to generate evidence on current referral practices for pregnant women in India.

Aim and Objectives

The aim of my PhD research was to study the public health referral systems and transport for emergency obstetric care in India. Specific objectives were:

1. To describe the key issues regarding referral pathways for emergency obstetric care in the public sector health systems in India.

Referral between health facilities for obstetric care

2. To summarise the evidence on the extent of referrals, and associated factors influencing referrals, within Indian public sector facilities for women at obstetric high-risk, with complications, or emergencies.
3. To assess the knowledge, attitudes and practices of staff at places of delivery about referrals to higher levels of care for women with obstetric high-risk, complications, or emergencies.

Transport for pregnant women

4. To summarise the evidence on the effectiveness of transport interventions in emergency obstetric care in India.
5. To describe the socio-demographic and clinical characteristics, and pregnancy outcomes, of pregnant women who called the '108' ambulance service for transport.

Methods

I conducted a critical review and two systematic reviews to generate evidence from India[1] for objectives 1, 2 and 4. For objective 3, I surveyed health care providers at primary level public health facilities[2] and assessed their knowledge, attitude and practices (KAP) regarding obstetric care, referral decisions and pre-referral treatments provided. The survey was conducted across two states (Andhra Pradesh and Himachal Pradesh).

I studied the largest emergency referral transport intervention in India—the free '108' ambulance service—in detail, and analysed call-centre data for one year (April 2013–March 2014) from six states (Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Himachal Pradesh and Telangana). I also conducted a cross-sectional survey of women who were transported by '108' and women who called the '108' service but were not transported (objective 5), from two states (same as in KAP survey).

For the purposes of this study, obstetric emergency is defined as any complication in pregnancy or during labour or delivery, or after (42 days) delivery that is life threatening to the mother or foetus. Complication in pregnancy refers to any medical complication that developed or is complicated as a consequence of pregnancy. High-risk condition constitutes demographic or obstetric or medical condition that pose an elevated risk of occurrence of a complication in pregnancy. An institution referral is when a pregnant woman seeks care at a lower level health facility (basic birthing centre or basic emergency

[1] The Indian sub-continent, comprising of 29 states and 7 union territories, has vast differences in maternal health indicators and health service delivery between and within the states. The difficult terrains and political situations in regions also affect the access to health care.

[2] Primary level public health facilities in India comprise of Sub-health Centres that provide only antenatal care; Primary Health Centres provide basic birthing service or basic emergency obstetric care (only in a few); and Community Health Centres provide basic or comprehensive emergency obstetric care (in very few).

obstetric care) and is referred onwards to a higher level health facility (basic or comprehensive emergency obstetric care)

Results

The critical review found that there were no documented standard protocols and guidelines for the referral of pregnant women with high-risk conditions or complications in India, and several factors contributed to poor quality referral systems.

Referral between health facilities

The systematic review on institution referrals of pregnant women included 13 research studies (Chapter 4, *published paper*) and found that the proportion of institution referrals was high with over half of all pregnant women attending primary level health facilities in India referred to higher level facility, during pregnancy or delivery. The high proportion of institution referrals in India point towards the inability of primary health facilities to provide basic birthing services and basic emergency obstetric services. The evidence suggests poor quality of referral care: inadequate pre-referral stabilising care, a tendency for unjustified referrals to higher levels, bypassing Community Health Centres as the first referral choice, inadequate referral communication and record maintenance, absence of standard guidelines for referral and monitoring of referrals for obstetric care.

From my health providers' KAP study (Chapter 5) I found that staff in primary level public health facilities had sub-optimal knowledge of, and practice for, screening of common high-risk conditions and complications in pregnancy and childbirth. Only one quarter of staff mentioned screening for all common high-risk conditions and early complications in pregnancy. There were also large gaps in knowledge of first-aid for obstetric complications. Staff at Sub-health Centres referred all delivery cases. Only half of the staff at Primary and Community Health Centres managed common high-risk

conditions in delivery, and between a quarter and half have managed common complications in delivery. Staff generally had low confidence, did not have adequate resources, and believed that some complications should only be managed at higher levels by obstetricians. Nurses had limited roles in decision making and managing pregnancies with complications, and when doctors were not available they referred cases. Staff desired skill building, mentoring, moral support, and motivation from senior officers. Poor management of blood services and other logistical issues in clinical supplies have also contributed to a large number of referrals.

Transport for pregnant women

The systematic review of the literature (Chapter 6) found that there was insufficient evidence on the effectiveness of transport interventions on institutional delivery, morbidity or mortality rates in India. However, there is some evidence that free transport services are more likely to be used by poor women from backward castes and rural areas.

From my analysis of population and '108' ambulance data (Chapter 8, *papers published*), I have estimated that only 17% of pregnant women and 21% of women having institutional deliveries used the '108' ambulance service across the six study states. Among the pregnant women transported by '108', most called for normal labour. Only 4.3% had an obstetric emergency[3] and only 5.8% were inter-facility transfers[4]. Pregnant users for inter-facility transfer were less likely from socially disadvantaged castes, below poverty line, rural areas and from high priority districts, compared to non-inter-facility transfers.

[3] In the '108' call data obstetric emergency includes any medical complication in pregnancy at the time of call to '108'. The complication was recorded as stated by the pregnant woman or the person who called for her.

[4] Inter-facility transfer, for this study, was defined as any transfer of a pregnant woman from one health facility to another health facility on the advice of a health care provider, using '108' ambulance service.

Although use of '108' ambulance for obstetric emergencies was low, from telephone interviews with pregnant callers to the '108' service (Chapter 9, *paper submitted*), we found that one third reported a high-risk condition or early complication in pregnancy. Women transported using other means were more likely to use private facilities than those transported by '108'. There were no large differences in adverse pregnancy outcomes among those transported using '108' ambulance and those not transported by '108'.

Conclusions and Recommendations

A large proportion of pregnant women are referred in India. The quality of obstetric care at peripheral health centres is suboptimal and it is likely that the high proportion of the referrals could be avoided. Staff had poor skills, and low confidence for screening and management of high-risk conditions or complications in pregnancy. The sub-standard referral system is due to an absence of standard obstetric care, mentoring and motivation for staff, and absence of protocols, communication, and monitoring for referrals.

Transport services are critical to efficient referral systems. The '108' service is the most prominent mode of free transport for pregnant women in India but it is underused in pregnancy, especially in emergency situations.

Recommendations from this research are that the health systems in India should improve the provision of obstetric care by standardising services at each level of health care, increasing focus on first-aid for complications, appropriate decision-making for referral, and improving referral communication. Guidelines and agreements are required to establish referral pathways and continuity of care. Strategies are required to increase the use of '108' services for obstetric emergencies and inter-facility transport—a free ambulance service will reduce out-off pocket expenditure for these women and improve

compliance to referral of women from socially disadvantaged castes and below the poverty line. Indicators to monitor referrals, and referral transport, should be incorporated in plans for monitoring the quality of obstetric care (Chapter 10).

SECTION A

Introduction

CHAPTER 1: BACKGROUND AND KEY CONCEPTS

1 BACKGROUND

Worldwide it is estimated that about 303,000 women die due to maternal causes per year. Trends show that the number of deaths has declined by 43% in the 25 years between 1990 and 2015. However, 99% of deaths still occur in low and middle income countries and the proportion has not changed since 1990. Two-thirds of these deaths occur in Sub-Saharan Africa and one-quarter in South Asia. At the country level, India accounts for 15% of global maternal deaths (45,000) per year and has the second highest number in the world, behind Nigeria (58,000).(1) The majority of maternal deaths are still due to direct obstetric causes. Most obstetric complications, except those due to abortions, occur during delivery and immediately after delivery. Perinatal deaths are also known to have causes originating in pregnancy or during delivery. One in three stillbirths occurs during delivery and are largely preventable.(2) About 98% of perinatal deaths occur in low and middle income countries.(3) Globally, the neonatal mortality rate fell from 36 deaths per 1,000 live births in 1990 to 19 in 2015. India accounts for 26% (696,000) of global neonatal deaths.(4)

Countries around the world were committed to reduce the Maternal Mortality Ratio (MMR) by 75% between 1990 and 2015, the Millennium Development Goal (MDG)-5, by providing equitable and adequate maternal health services. One of the focus areas was training Skilled Birth Attendants (SBA)[5] and providing Emergency Obstetric Care (EmOC) to all. The proportion of deliveries worldwide attended by skilled health care personnel

[5]An SBA is an accredited health professional with midwifery skills-such as a midwife, nurse, or doctor or others at any level of facility who have been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancy, delivery, and immediate postpartum period, and in the identification, management and referral of complications in women and newborns.

increased from 55% in 1990 to 65% in 2012, and the proportion of women who were attended to by skilled health care personnel at least once during pregnancy increased from 64% in 1990 to 83% in 2012.(5) The global estimates for Maternal Mortality Ratio (MMR) decreased from 440/100,000 live births in 1990 to 216/100,000 live births in 2015 (1), and most countries were far from achieving MDG-5.

Services provided for improving the availability, accessibility, and quality of treatments for complications that arise during pregnancy, delivery and postpartum are collectively known as emergency obstetric care, EmOC.(6) Not all EmOC services can be provided at the clients' door step, especially in resource-poor countries. Thus, these are provided through a primary health care system consisting of different levels of care linked by a referral system. The following levels of care were identified by WHO for general obstetric care in 1991: i) family/community, ii) health centre, and iii) first referral centre. The first referral level was originally defined as a district or Sub-district hospital, to which a woman at high-risk is referred in the antenatal period or sent for obstetric complications.(7) For EmOC, the levels of care are now classified as; i) Basic emergency obstetric care (BEmOC), and ii) Comprehensive emergency obstetric care (CEmOC).(6) BEmOC centres are equivalent to primary health centres and CEmOC centres are first referral centres or above, with more specialised services. However, defining any level of care is not appropriate for countries where there are centres which provide some obstetric care but do not fully qualify to be a BEmOC or where delivery services are provided by a SBA at home. Private doctor or nursing homes which are not accredited are also difficult to categorise into levels of emergency obstetric care. Gabrysch et.al. suggested another level of health centre– a delivery or birthing centre- which is a level below a BEmOC centre and which provides routine obstetric care and plays an important

role in prevention, management and referrals for complications. These birthing centres provide services such as monitoring and management of labour using a partograph, infection prevention measures, and active management of third stage of labour.(8)

A systematic review on interventions for improving maternal health observed that most successful programmes focused on training for CEmOC, the placement and motivation of care providers, refurbishment of existing health institutions, and establishment of referral and transportation systems.(9) The interventions included in the review focused on improving self-referrals, with only a few on interventions to improve referrals between institutions, the number and quality of institution referrals, and transport for between-institution transfers.

2 KEY CONCEPTS ON REFERRALS IN OBSTETRIC CARE

In this section I describe delays to obstetric care, the role of referrals, and factors affecting referrals. The definitions related to obstetric referral, complications and emergencies are described in Annex-I.

2.1 Delays in access to obstetric care

A three-delays model to explain delays in access to appropriate obstetric care was first described by Thaddeus and Maine in 1994 (10) and was later redefined by Gabrysch and Campbell in 2009.(11) Thaddeus and Maine proposed a model mainly for emergency care seeking behavior while Gabrysch and Campbell elaborated the model to include preventive care seeking (see table-1 and figure-1).

Preventive care seeking: The delivery is intended at a health institution for normal labour. When a complication arises, the client is managed at the facility, or is referred.(11) This model is used for the understanding of contributing factors to delay in accessing

institutional delivery. It focuses on self-referrals for normal delivery and institution referrals for obstetric emergency.

Emergency care seeking: The delivery is intended at home and when an obstetric complication arises the client may seek care.(10, 12) This model is widely used in the understanding of contributing factors to maternal mortality. It focuses on self-referrals for obstetric emergency and its outcome.

Table 1: The 'Three delays' model for access to appropriate obstetric care, according to type of care seeking (11)

	Preventive care seeking	Emergency care seeking
Phase I Delay in decision to seek care	Deciding to seek preventive care for delivery in institutions	Deciding to seek care for complication in delivery
Phase II Delay in reaching care	Identifying and reaching health facility (includes transportation)	Identifying and reaching health facility (includes transportation)
Phase III Delay in receiving adequate health care	Receiving 1. Normal delivery care at the delivery point or 2. Referral and transfer to higher facility for high-risk / early complications / complications in delivery	Receiving adequate and appropriate treatment for complications in delivery

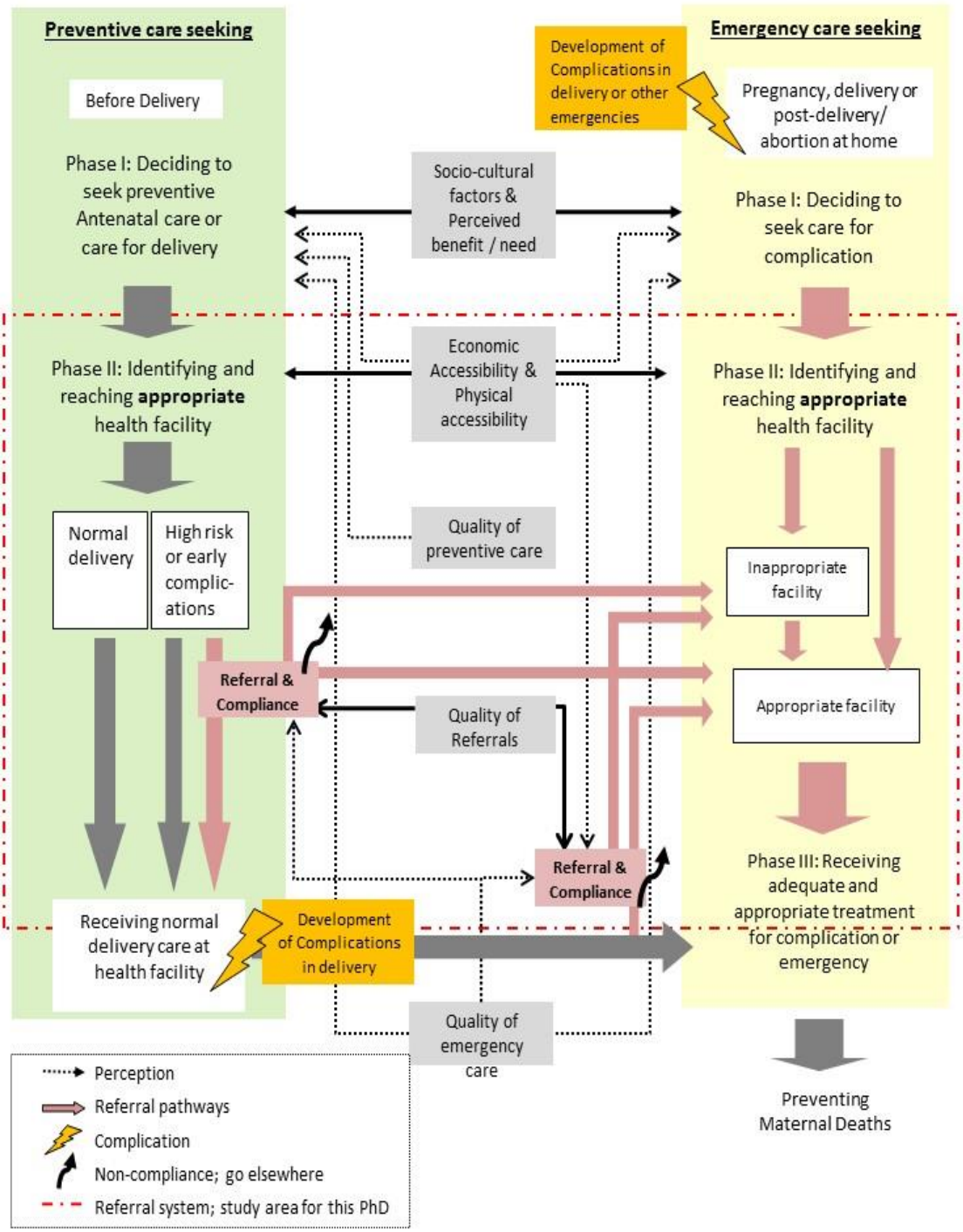
Limitations of these models:

1. The emergency care seeking model does not consider delays for emergencies arising during the antenatal period and postpartum.
2. The preventive care seeking model does not consider routine institution referrals for high-risk pregnancies or early complications before delivery, and compliance to referral. Referred clients may; i) comply, ii) go back home, iii) go elsewhere or iv) deliver in the same institution.

3. Both models talk about reaching appropriate health facilities in the phase II delay, but this may also contribute to phase III delay – not getting appropriate care if the referral has been to an inappropriate facility. Some clients may go through multiple facilities before finally reaching the appropriate facility and, loose time even after being within the health system.

Figure-1 describes referral pathways within the three delays model. This model was adapted by me from the model presented by Gabrysch and Campbell.(11)

Figure 1: Conceptual framework for phases of delay, referral pathways and factors affecting institutional delivery care and maternal mortality. (Adapted from Gabrysch and Campbell) (11)



2.2 Referral for EmOC

Referral is defined as any movement of health care seeking by individuals usually, but not exclusively, from the lower to higher level of care in the health systems, whether advised by a health worker or not.(13) Referral from a higher level to a lower level is called back referral, and is done for follow up care or regular care that could be provided at low cost and closer to the patient's home. In emergency obstetric care the referrals are mostly from a lower to a higher level for better care.

The terminology used for referral, obstetric complication and emergency, and delay are not standard. I have defined key terms in Annex-I for a better understanding of the concept of referrals in emergency obstetric care.

The term referral is used in different ways, for instance referral by self, community health worker or health staff, and also referral for uncomplicated facility delivery, antenatal check-up, high-risk or complications.

Obstetric complications have a different spectrum and urgency for referral. A woman with a high-risk pregnancy may require referral for further antenatal care or delivery, an early complication in pregnancy may require referral on urgent basis (within 2-3 days), and an emergency complication will require immediate transfer. Each of the complication states will also require different referral pathways.(14, 15)

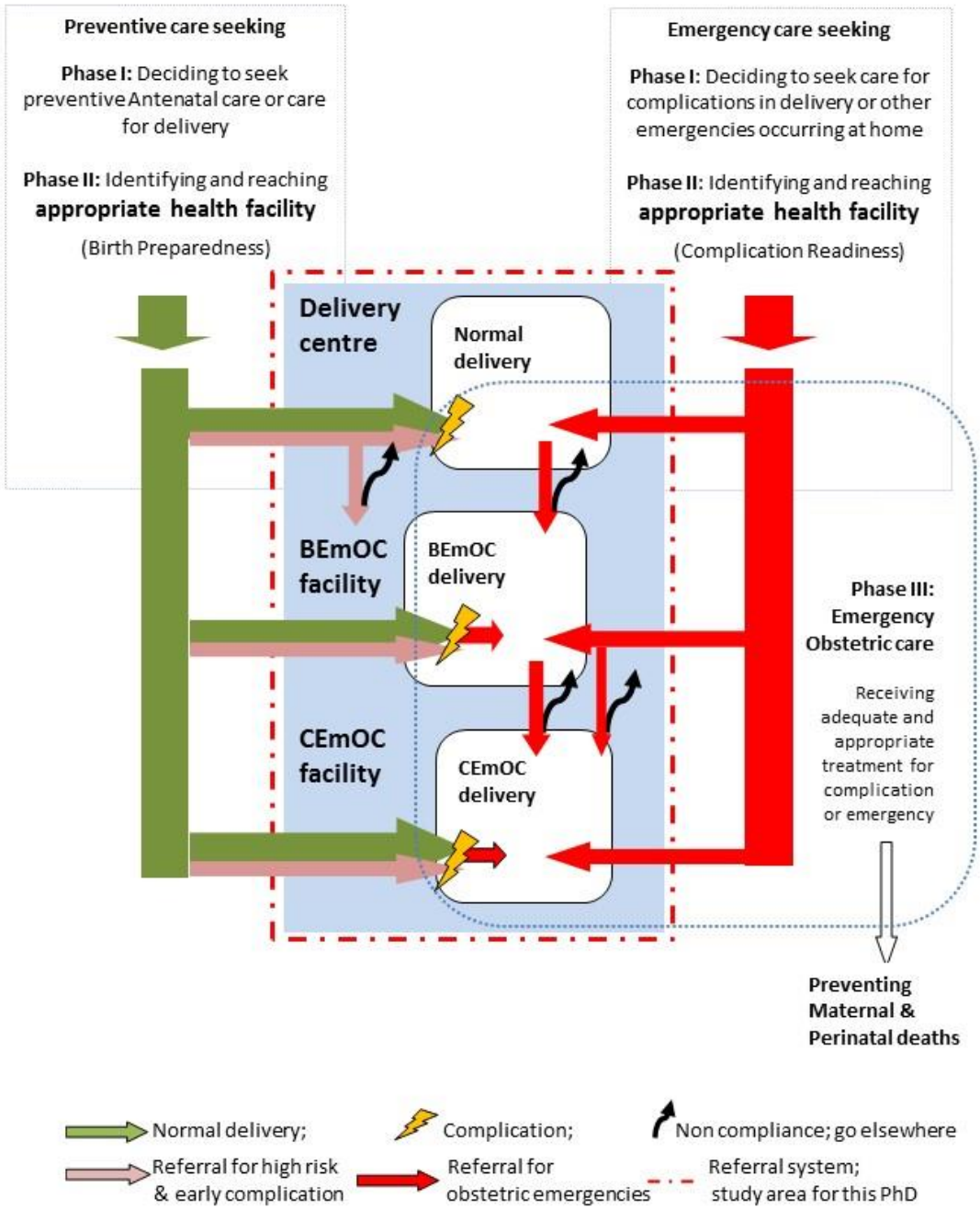
Definition of delays and their causes are subjected to regional socio-cultural structures, health systems and complexity of inter-institution and public-private referrals. Although the clinical basis and principles for referrals may be similar, the referral systems used in practice are specific to regions.

Studies in Africa show that most women seeking care at first referral centres or CEmOC centres are self-referred for normal delivery (without any medical indication). The

proportion of institution in-referrals for women with obstetric high-risk or complications is much lower.(16) This skewed referral pattern results in an inappropriate use of referral level care by bypassers of primary level services. This often creates overcrowding at these referral facilities and affects the access and quality of specialised care to those who actually need it. Self-referrals seem more relevant when they are for obstetric high-risk women.(17) At the same time it is not justified to refuse a higher level of care to those who reach the referral centres for normal delivery when the quality of care and referral systems at the lower centres are not up to standards. Thus resource poor countries struggle to deal with the issue of rational utilisation at each level of care and inefficiencies in referral systems.

Referral pathways are spread through phase I, phase II and phase III of care seeking and are vital in reducing delays (figure 2, prepared by myself). Table-36 in Annex-I describes factors within referral systems that contribute to delays in accessing EmOC.

Figure 2: Conceptual framework of referral pathways in EmOC



2.3 Referral systems for EmOC

A referral system is defined as a system within the general health systems that provides access to treatment and skills linked through appropriate referrals.(13) Referral systems aim to ensure accessibility to the appropriate facility without delay, especially in regions

where a large proportion of deliveries are assisted by SBAs at birthing centres or inadequate BEmOC centres. A referral system involves two-way movement of health seeking individuals, including back referrals with advice from health personnel.

To refer a woman should be a medical decision. The appropriateness of the decision will depend on the skills of the referring health staff, the tools for diagnosis, the availability of a health centre with specialist facilities, the quality of care at the referral facility, cost of care, distance, transportation, communication, accompanier and feasibility of the patient to travel.(17)

Inefficient referral systems contribute mostly to the phase II delay, that of reaching an appropriate level of facility. There have been several interventions in resource poor countries to overcome the barriers to effective referrals.(18) Table 2 summarises these interventions.

Most interventions in phase 2 are relevant for those seeking care for normal delivery (without medical indications) as well as those seeking care because of complications. These do improve the timely transfer of patients, which is integral to any referral system, but they do not address the quality of referral advice.

Misdirected referral may send the patient to a facility that is incapable of managing the referred condition, which will also lead to phase II delay. This may even increase the severity of the complication in due course. An inefficient referral system may also contribute to phase III delay, that of receiving appropriate care after reaching a facility. This may be due to non-readiness of the institution in the absence of communication about an arrival, and lack of medical information about the diagnosis and treatment already provided (inadequate referral).

Table 2: Barriers leading to phase II delay for EmOC and interventions to reduce these barriers.(18)

Barriers	Interventions
Distribution and location of health facilities and personnel	-Bring facilities closer by establishing EmOCs or basic birthing centres with SBA -Improve referral guidelines and practices of health providers
Decision for a transfer to an appropriate facility -quality of care (perceived barrier for compliance)	-Education for identification of danger signs and timely referral -Training to improve quality of referral -Enhance quality of care at referral institution
Travel time	-Maternity waiting homes for mothers
Transport / communication	-Birth preparedness and complication readiness -Arrange for ambulance by public/NGO schemes -Motorised vans/bicycle/palki/ vehicles arranged by community -Community emergency transport funds -Establish radio/telephonic communications
Costs	-Incentivise institutional deliveries and transportation -Voucher schemes for transportation -Schemes subsidising emergency care (eg. Surgeries) -Community emergency funds
Designate a person to overcome barriers and accompany patient	-Birth companions, traditional Birth Attendants or other community health worker

Appropriate referral is an integrated component of quality of obstetric care during pregnancy, child birth and post child birth. Recently the WHO launched recommendations for antenatal care and for positive pregnancy care.(19) The guidelines emphasise appropriate maternal and foetal assessment during antenatal care, timely identification of medical or obstetric complications and high-risk pregnancies, and provision of appropriate treatment and referral. WHO also launched standards for improving quality of maternal and newborn care in health facilities, which focus on early high-risk and complication screening and provision of appropriate care.(20)

Successful implementation of each referral system needs: a referral strategy informed by the assessment of population needs and health systems capabilities; an adequately equipped referral facility; specific referral protocols; active collaboration between referral levels and other sectors; instituted communication and transport arrangements; affordable service costs; supervision and accountability for quality of care; the capacity to monitor effectiveness; and policy support.(15) Availability of functional EmOC facilities should be ensured before developing a sound referral system.

Compliance to referral may depend on the counselling skills of the referrer, beliefs of the client (mostly client's caretakers), perceived need, quality of referrals and perceptions of quality of care at the higher facility to which referred.(17) Socio-cultural and economic factors play a role at each level of decision making. Distance to the referral facility and transport availability also affect compliance.

A good referral mechanism helps in judicious redistribution of cases in the facilities, thus avoiding underutilisation of some centres and over-crowding at others. In some countries, including India, there are a large number of unregulated private health facilities contributing to health systems. These facilities are not accredited for EmOC services. The complexity of referral pathways increases when private institutions are equally or more preferred than the government public health systems. The conceptual framework in figure-2 will work for mixed health systems if accreditation of private institutions could be insured. However, tracking the clients who seek care interchangeably between the public and private sector would be challenging.

CHAPTER 2: OBSTETRIC CARE IN INDIA AND RATIONALE FOR THE STUDY

1 STATUS OF OBSTETRIC CARE IN INDIA

India is the seventh largest country in the world and second in population size. The 2011 census estimated the Indian population to be 1.21 billion with a decadal growth rate of 1.7%. Females make up 48.5% of the population. It has a literacy rate of 73% (Males 81%; Females 65%).(21) The World Bank estimated a crude birth rate of 21/1000 population and total fertility rate of 2.5 children per woman for India in 2012.(22) It has approximately 27.1 million live births and 45,000 maternal deaths each year.(1) The MMR was estimated to be 167/100,000 live births (23) and the Perinatal Mortality Ratio (PNMR) was 17/1000 live births in 2011-13.(24) Although there was a 62% reduction in the MMR between 1990 and 2015,(25) India did not achieve the MDG-5 target of 75% reduction in MMR between these dates.(1) The new Sustainable Development Goals (SDGs) target-3.1 is to reduce MMR to 70/100,000 live births by 2030.(26)

To reduce maternal mortality India has a target that 80% women deliver in health facilities and 100% deliveries are attended by SBAs.(27) In the Reproductive and Child Health (RCH) –I programme (1998-2005), India focused on strengthening infrastructure and SBA training, which continued in RCH-II (2005 onwards). These efforts did not bring a substantial increase in institutional deliveries or a reduction in the MMR.(28)

The Ministry of Health and Family Welfare launched the National Rural Health Mission, in 2005 to strengthen rural public health care throughout the country, with special focus on 18 states.(27) NRHM focused on providing a community companion, cash incentives, transportation for pregnant women, and community mobilisation. NRHM introduced the

Accredited Social Health Activist (ASHA)[6] and initiated *Janani Suraksha Yojana*[7], a cash incentive scheme to promote institutional deliveries.(27) Another state-run cash incentive scheme, the *Chiranjeevi* scheme in Gujarat, made available free surgical obstetric care to the poor through empaneled private doctors or clinics.(29) Several studies have been conducted to assess the efficiency of *Janani Suraksha Yojana* and *Chiranjeevi* schemes for increasing institutional deliveries and reducing maternal mortality. An evaluation of *Janani Suraksha Yojana* in 2008 in five poor performing states showed that 47% of women who delivered at institutions were the direct beneficiaries of *Janani Suraksha Yojana*. The majority of deliveries within health facilities occurred in PHCs.(30) A research study showed that the *Janani Suraksha Yojana* clearly increased institutional deliveries, but a corresponding reduction in the MMR was not achieved.(31)

In 2011, the NRHM launched *Janani Sishu Suraksha Karyakaram*[8] to further strengthen the availability of services for mothers and children.(32) Recent maternal death reviews highlighted that time was lost in arranging for transport and in being referred to inadequate facilities.(33-35) Many mothers had multiple referrals before succumbing to death.(36, 37) The quality of care provided at the facilities was sub-optimal.(36) The Reproductive Maternal Neonatal and Child Health + Adolescent (RMNCH+A) strategy launched in 2013 focused on the lowest 25% of districts in each state of India with respect to the performance in RCH indicators.(38) In 2015, *Dakshata* quality improvement

[6]An ASHA is selected from each village and accountable to it. She is a health activist who creates awareness of health and mobilises community for increased utilisation of health services. Under RCH programme, she receives performance-based incentives for promoting universal immunisation, referral and escorting pregnant women.

[7]The JSY encourages women to make use of public (government) health facilities for safe delivery by offering a cash incentive to cover travel costs and other expenses. It also provides cash incentives to ASHAs for promoting safe care in pregnancy and facilitating access to institutional care.

[8]*Janani Shishu Suraksha Karyakaram* provides completely free and cashless services to pregnant women, including normal deliveries and caesarean operations, and sick new born (up to 30 days after birth) in government health institutions.

programme was launched countrywide to improve care during institutional delivery by making use of the 29 item WHO Safe Childbirth Checklist.(39) Another initiative, *Pradhanmantri Surakshit Matritva Abhiyan* was launched in 2016 to improve access to obstetricians for antenatal care. The services will be provided on the 9th of every month for comprehensive and quality antenatal care. The programme seeks support from private sector obstetricians to volunteer and supplement the efforts of the public sector.

For strengthening transportation, NRHM developed a partnership with GVK Emergency Medicine Research Institute (GVK-EMRI) (40) in 2007 and initiated a call centre based ambulance service for all, including pregnant women, in some states (the 108 service). NRHM has recently strengthened the National Ambulance Services and started a 102 call centre based service focused primarily on mothers and children, in addition to 108 service.(41) Some state level and local interventions to improve transport availability are also operating.(42)

Table 3: National programmes and schemes for obstetric care in India since 1997-2016

Programmes and schemes	Main focus of the programme and schemes
Reproductive and Child Health programme –I (1998-2005) and RCH-II (2005 onwards)	Promote institutional delivery and Skilled birth attendance
National Rural Health Mission (2005)	Strengthen health systems including obstetric care
Accredited Social Health Activist (2005)	Community mobilisation for obstetric care and birth companion
Janani Suraksha Yojana (2005)	Cash incentive for institutional delivery
'108' and '102' Ambulance Service (2007 onwards)	Free ambulance service also covering pregnant women and newborn
Janani Shishu Suraksha Karyakaram (2011)	Free medicines and other support for institutional delivery
Reproductive Maternal Neonatal Child Health + Adolescent (2013)	Focus on high priority districts in each state
Dakshata programme (2015)	Improve quality of care during institutional delivery
Pradhanmantri Surakshit Matritva Abhiyan (2016)	Improve access to specialists for antenatal care

The public health systems provide free health promotion along with preventive and curative care, but some cost is incurred in buying medicines prescribed out of hospital. Data from the District Level Health Survey 2007-8 (DLHS-III) shows that an average woman spent INR 2,174 (rural-INR 2,052 ; urban-INR 2,406) on delivery costs (excluding transportation cost) in a government facility, and INR 7,058 in a private facility (rural-INR 6,137 ; urban-INR 8,035).(43) These amounts increased by 50% by 2015-16.(44)

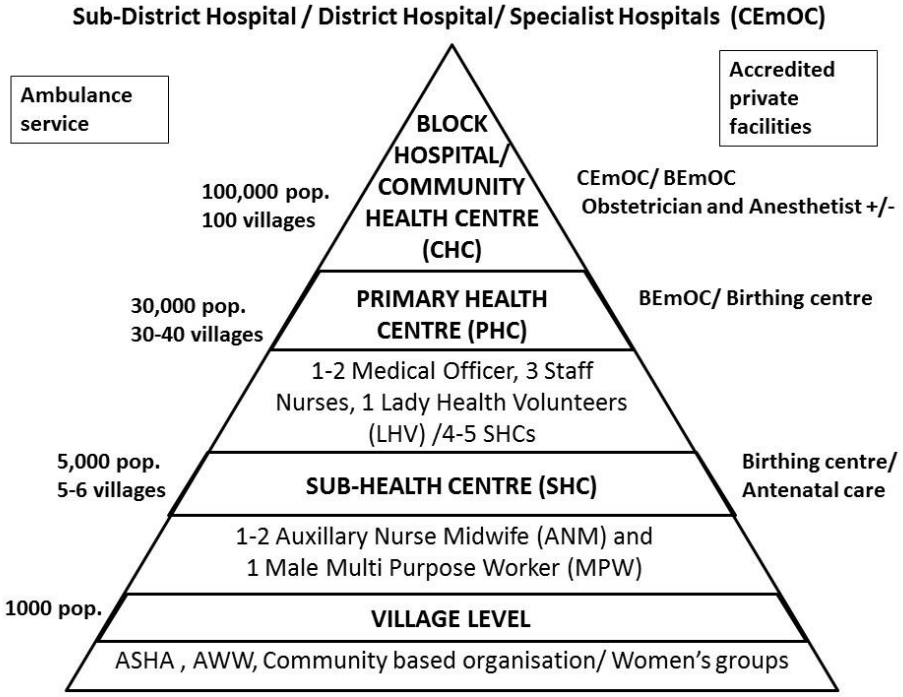
Cash support schemes like *Janani Suraksha Yojana, Janani Shishu Suraksha Karyakaram* and *Chiranjeevi* provide some financial support. There are a few social franchising initiatives under public-private partnerships in Uttar Pradesh to increase institutional deliveries and quality of care. One such initiative is the Merrygold health network that aims to provide subsidised obstetric care by strengthening and accrediting EmOC care in the franchisee institutions, and to link them with a referral CEmOC franchisee institutions.(45)

2 ORGANISATION OF THE PUBLIC SECTOR HEALTH SYSTEMS IN INDIA: CURRENT CAPABILITIES IN PROVIDING EMERGENCY OBSTETRIC CARE

India has a national public health sector which provides free care, and a prominent private sector which charges for services and is largely unregulated. The discussion which follows concerns the public health sector only. In rural areas, provision of public health services starts at the village level, and are provided by community workers including ASHAs, *Anganwadi* workers (AWW) and Village Health Nutrition and Sanitation Committees (VHNSC) (figure-3). They provide community mobilisation for various health programme components, mainly for maternal and child health.

The next level is the Sub-health Centre (SHC), where Auxillary Nurse Midwifes (ANMs) provide antenatal care. In a few poor performing states, ANMs who are trained for SBA provide delivery care at the SHC or at home.(46) ANMs in most states are provided with telephones to help them communicate with higher level health facilities. Less than half SHCs have a Male Multi-purpose Health Worker (MPHW) who supports ANMs in outreach activities.(47)

Figure 3: Rural health systems for obstetric care in India



The Primary Health Centre (PHC) is the first level where a doctor is available, supported by 1-2 staff nurses and other staff. Two-thirds of PHCs have a labour room but in poor performing states the proportion is low – 38% in Himachal Pradesh, 42% in Bihar and 45% in Uttar Pradesh.(48) Not all PHCs having labour rooms are conducting deliveries.(49) Only a few PHCs operate 24x7 and are equipped to provide BEmOC care, the majority provide only birthing services. One-half of PHCs have a telephone and a computer, however

electricity and connectivity are often interrupted in rural areas. About 44% PHCs have transport for outreach and are able to transfer patients to higher centres.(48)

The block level hospital or Community Health Centre (CHC) acts as a referral centre for PHCs. CHCs should have specialists (obstetric and surgical) but due to limited human resources, only one third of CHCs have obstetricians.(50) Although four-fifths CHCs have operation rooms, only a few have been upgraded to first referral units with availability of blood transfusion facility. Thus only a few CHCs are working as CEmOCs and most still work as BEmOC centres.(46) About 90% of CHCs have referral transport.(51) Above CHCs, there are Sub-district hospitals, Maternity hospitals and District hospitals with a blood bank or a blood storage facility. These are first referral units and should act as CEmOCs, but only 50% conduct caesarean sections.(51, 52) Next to them are medical colleges and other specialised hospitals which are largely located in urban areas.

In urban areas, some big cities have dispensaries, urban health centres and urban health posts for preventive and primary level curative care. But largely the urban population depends on public tertiary level institutions or the private sector for health care. Due to inaccessibility and mistrust in the quality of government health institutions, even the poor prefer to go to private clinics or hospitals when complications arise.(43) The sixth review of NRHM estimated that only 22% of out-patients and 64% of in-patients visited public sector facilities. The rest presumably went to the private sector or to Municipal Corporations, whose data were not included in the review.(46, 47) The private sector can range from a private general practitioner within a village or town to a nursing home and a privately run tertiary hospital. To date there has not been any formal mapping of private institutions and the services provided by them.

3 REFERRAL FOR EMERGENCY OBSTETRIC CARE IN THE PUBLIC SECTOR HEALTH SYSTEMS IN INDIA: A CRITICAL REVIEW

3.1 Background

A review of maternal referral systems in developing countries published in 2006 suggested that many healthcare systems in low and middle income countries were failing to optimise women's rapid access to emergency obstetric care.(15) The review concluded that successful referral systems should be directed by policy, supported by capable health systems and health programmes, and operationalised through structured referral protocols, collaborations and supervision.(15)

There have been many government attempts to improve obstetric health care in India. The 2002 National health policy of India (53) stated that all deliveries should be conducted by an SBA and 80% of deliveries should be conducted in health institutions. The policy aimed to strengthen health infrastructure and ensure a well-structured referral system. The National health policy-2017 of India (54) recognised that there were lacunae in quality of antenatal care, and often the standard protocols for care during delivery and postpartum period were not followed. The policy proposes improvement in quality of health care and a shift in primary health care from a *selective care* that is fragmented to *assured comprehensive care* that has continuity with higher levels. It envisages that a patient should be transferred to a referral facility in the "golden hour"—first hour following recognition of a complication, within which treatment and resuscitation should be provided—through efficient and affordable transportation systems.

The RCH programme promotes appropriate antenatal care, birth preparedness and complication readiness for institutional delivery. In the absence of any high-risk or complication, an SBA-run birthing centre or BEmOC is the recommended choice for

delivery. Guidelines about the management of labour and complications, and when and where to refer, are stated in training manuals for SBAs.(14) The manuals also state that SBAs should arrange transportation for pregnant women in cases of emergency referrals.(14) The RMNCH+A strategy for high priority districts specifically emphasises strengthening the skills of health staff. It promotes identification and line-listing of high-risk and maternal complication cases, including severe anaemia, and quality of care and referral.(32)

Despite these extensive health programmes in India, evidence suggests that institution referral for obstetric emergencies is the weakest link in access to care.(37, 55, 56) I conducted this review to explore issues and concerns within the public health systems with regards to institution referrals for emergency obstetric care in India. The aim was to identify knowledge gaps for future research.

3.2 Methods

The literature search was conducted using Medline, Embase and databases from WHO, UNICEF, UNFPA and Indian RCH repository. Indian policy and RCH programme documents were also used. The search strategy was based on the following keywords: referral, referral system, pregnancy, obstetric care, emergency obstetric care, transportation for pregnant women and delay in obstetric care. Most relevant scientific papers, reviews, reports and editorials were included.

Apart from results from the literature review, findings also include information gathered from stakeholders while retrieving the programme documents and reports.

3.3 Results

3.3.1 Variable EmOC services in health centres

Despite continual efforts, health facilities in India do not have the capacity to adequately manage women with obstetric complications. A study including four states from 2012, found that the designated EmOC centres are not providing all the required signal functions.(57) Rural health statistics 2014-15, show that one-third of PHCs across India do not have labour rooms, and the ones with a labour room may not have all the services of a BEmOC.(48) Similarly, CHCs and Sub-district hospitals that are designated as first referral units (58) may not have all the services of a CEmOC.(48) Over 50% of ANMs and staff nurses are not competent to conduct deliveries and manage early complications, thus the quality of care at the birthing centres is also inconsistent.(46, 59) With such variability in provision of EmOC it is difficult to have national level referral guidelines on where to refer. As a consequence, community and staff at peripheral centres are not aware of the availability of services at the referral level and may misdirect a pregnant woman (misdirected referral). In a study from Karnataka, all bad maternal outcome cases were referred to multiple centres before reaching the centre where they delivered.(36)

3.3.2 Geographic (in-) access to EmOC

Some districts in India are as large and populous as some small African countries. Even if there is a CEmOC at district headquarters, it can be very far from villages. About 60% of rural villages have a CHC more than 10 kilometres away, and more than 82% have a District hospital more than 10 kilometres away.(43) A study from Karnataka reported that there is an inequitable geographic distribution of EmOC centres at sub-district and district headquarters.(52) Most EmOC facilities in Karnataka and Gujarat are in the private sector and these too are restricted to bigger cities and towns.(52, 60) The study from Karnataka

found that only 20% sub-district divisions had access to a functional EmOC (public or private).(52) Private EmOC also have variable services and some may provide caesarean facility but may not have basic EmOC services. The Indian government does not encourage referral of pregnant women to private facilities.

Some PHCs and SHCs are not accessible by road.(48, 49) As per guidelines, in tribal areas PHCs and CHCs (BEmOC) shall have attached maternity waiting homes where the pregnant women can go at the expected time of delivery and wait.(61, 62) There are no data on utilisation rates of these waiting homes in India. In large cities the distances can also be large and amidst traffic a lot of time may be lost in reaching the facility.(63, 64)

3.3.3 Referral practices

A study from Gadchiroli showed that 17% pregnant women developed one or more complications at the time of labour, and 43% women in the postpartum period. Of these, 15% needed emergency obstetric care and 24% needed some medical attention (non-emergency).(65)

i. Self-referrals and Bypassing

As per guidelines,(66) pregnant women in India are to be educated to identify high-risk states and symptoms of complications, and the appropriate place to visit. ANMs and ASHAs have the prime responsibility to counsel women for birth preparedness and complication readiness.(14) However, the extent of counselling practice in the antenatal period may vary.(67-69) The NFHS-4 survey from 2015-16 found that about two-thirds of pregnant women were informed about common complications, and which facility to visit if they experienced any complication.(70) The women with lower levels of education and poorer economic status were less likely to be counselled for complications and appropriate places for delivery.(70)

The status of women, religious and cultural beliefs, the perception of severity of complications and the availability of referral transport influences decision-making for a home delivery or self-referral for institutional delivery.(71-73) In several cultures in India, pregnant women tend to move to their mothers' home for delivery care, and deliver in a health centre in the new location or choose to deliver at home.(personal observation) Pregnant women may identify an appropriate health centre as per recommendations from health staff, or they may choose to bypass a lower level care centre and deliver in a tertiary care facility. Studies from the north of India found that the decision for place of delivery is based on the perception of quality of care and trust in the facility, respectful care, familiarity with the facility, geographic access, motivation by the staff, costs (formal and informal), and also the convenience of obtaining the monetary incentive for institutional delivery. (71, 72, 74, 75) Several women in these studies were dissatisfied with the quality of care in public health facilities and felt that delivering at home would be more appropriate option. Family members often also refused to take the woman to a suggested referral facility because of dissatisfaction with the services in the referral facility or long distances. P and R Jeffery , in an ethnographic study from Uttar Pradesh, state that it is not appropriate to promote institutional deliveries when the health system cannot provide quality and respectful care, and fails to address issues of long standing mistrust in the public health systems.(72)

In urban areas poor women still deliver at home (63) and others deliver in higher level public institutions (CEmOCs) or private institutions as there are not many accessible public intermediary (BEmOC) institutions for quality delivery care.(76)

ii. Institution referral

Screening for high-risk and early complications is an important component of adequate antenatal care.(14) Common indications for referral include severe anaemia, hypertension in pregnancy, and sepsis.(14) However reports suggest that, despite adequate availability of equipment and reagents, haemoglobin estimation, blood pressure measurement and abdominal examination were not conducted during ANC in many states. There was a gap in the skills of ANMs related to blood pressure and haemoglobin estimation.(34, 46) There is no recent evidence on the proportion of referrals in the antenatal period.

In a birthing centre run by staff nurses in Rajasthan, 21% of women in labour had a life-threatening complication or its antecedent condition, and 16% were advised referral.(77) In an urban midwife-run birthing centre in Tamil Nadu, 36% were referred to the next level for management in labour.(59) A study in Madhya Pradesh on institution referrals found that about 14% of women delivering in any health facility required referral.(78)

A review of maternal deaths from Andhra Pradesh identified delays in the identification and referral of complications by the doctors and nurses (Case studies in box). They either did not have skills or commitment to identify complications, or they did not refer appropriately.(33) On the other hand, the peripheral staff might over-refer cases, even those that can be managed at a lower level (unjustified referral).(33, 78)

A qualitative study among health care providers in secondary level public health institutions in Uttar Pradesh found that several systemic and cultural factors within the health centre affected the quality of obstetric care and institution referrals.(71) Pregnant women with complication were examined or trialed for normal delivery, and several were referred without any management. Due to high load of deliveries and shortage of staff normal deliveries were conducted by nurses while only complications were attended by

obstetricians. Nurses had low confidence and poor decision-making power, and when the obstetrician was not on duty, even the slightest of complications were referred without management. The lack of a 24 hour laboratory, facilities for newborn complications, a blood transfusion facility and, water and electricity were reported reasons for the inability to manage the complications.(71, 78) Lack of such services, contributed to phase III delay in access to care even after reaching a health facility. In a study from the south of India, doctors (including obstetricians) mentioned that due to fear of blame in the event of a maternal death, and complaints from the family members about last minute referrals, they referred pregnant women with any high-risk condition and complication at an early stage.(55) On the other hand, wherever there were long distances to a referral institution and the availability of transport was uncertain, staff sometimes refrained from referring cases likely to worsen during transfer, as in Ladhak, in Jammu and Kashmir.(75) There was no coordination between the lower level and higher level institutions (71) and thus decision making for referral, and continuum of care across facilities, is likely to be less efficient.

A study from Uttar Pradesh found that women would accept referrals from PHCs to CHCs, but often defaulted when referred from CHC to tertiary care.(71) In case of complications, a few who could afford it preferred a private hospital for better quality of obstetric care.(71) The most poor and powerless people experience discrimination and ill behavior from the staff, to which the community reacts by withdrawal rather than complaint.(71, 72)

Case studies from Maternal Death Review in the state of Andhra Pradesh, 2012:*

1. *Delay in self-referral, unawareness about '108' and non-compliance*- (Name X): X was a 26 year old primigravida from Khammam district. She received regular antenatal check-ups by ANM but was never told about any symptoms of complications. During 7th month she developed swelling in feet. On the night of 13th June 2012, she had an episode of seizures at home. Her husband took her to a local registered medical practitioner. They walked for 2 hours to reach his clinic. The medical practitioner referred X to CHC but did not give any relevant medication. As X felt fine, the husband did not take her to the CHC. On 15th morning X again had an episode of seizure. ASHA worker called the ANM who arrived in an hour and immediately called '108' ambulance. X succumbed to death by the time ambulance arrived after half an hour.

2. *Referral of a home delivery, non-compliance and misdirected referral*- (Name Y): Y was third gravida with 2 live children and had no complications in previous pregnancies. She was an illiterate daily wager from Guntur district. During the current pregnancy she had 3 antenatal check-ups at the PHC. She delivered a live baby at home assisted by a traditional birth attendant. Unfortunately, the placenta did not deliver, and she had bleeding. The ANM of the village visited Y's home for post-natal visit and after examination referred Y to PHC. ANM was not equipped to give Injection Methergin and did not write a referral note. She requested the husband to call 108 ambulance service. The husband did not comply and in the meantime, Y developed severe bleeding. After much delay, the husband took Y to a local registered medical practitioner. The practitioner also suggested to take Y to PHC. No injections were given. Finally, husband called '108'. By the time '108' arrived, she had bled extensively. She died during transit to the health facility which was 17 kilometres away. It is also important to note that the PHC to which she was referred did not have any blood storage facility.

3. *Multiple institution referrals without any medical aid*- (Name Z): Z belonged to a scheduled tribe and lived in a remote village in Visakhapatnam district. She was primigravida and received antenatal checkups in PHC. Z visited PHC on 23rd May 2012 when she developed swelling of her feet. She was diagnosed high-risk due to high BP and severe anaemia. Relatives did not provide any details on medication provided at PHC. The PHC medical officer referred Z to CHC. The medical officer at CHC examined her and further referred to an Area hospital which was 55 kilometres away. Although CHC was equipped to provide BEmOC care for such case, they referred her. Z was transferred from CHC in a '108' ambulance. The senior staff nurse at the area hospital did not provide any medical aid and without intimating to the doctor on duty, she referred the case for a medical college in district headquarters which was 200 kilometres away from the CHC. The relatives instead took Z home by public transport. The next day they again took Z to PHC. PHC doctor having no choice suggested to admit Z but they returned home along with Z. After 7 days of first seeking help, on 30th May 2012, around 7pm Z died.

** I attended the maternal death reviews at districts in Andhra Pradesh.*

iii. Honouring institution in-referrals

A qualitative study conducted by me in Delhi slums in 2008-09 (unpublished) showed that many pregnant women referred from a Government dispensary were denied registration at the higher centre for delivery as they were already getting antenatal care at the dispensary. They were advised to visit the hospital only at the time of labour pains. These facilities, if overcrowded at the time, refused admission for such cases if they were not already registered. However, if a woman had a complication, institutions admitted her or referred her to another institution after stabilising. Such refusals or forward referrals were also reported during maternal death reviews for mothers from rural areas in Andhra Pradesh (illustration box- case study 3).(73) For these reasons many pregnant women preferred to register at secondary or tertiary institutions, or preferred to deliver at home.

iv. Institution back referrals

To rationalise the client load, back referral for the non-high-risk and non-complicated cases may be an option. In Delhi, the NRHM upgraded maternity hospitals (BEmOC) and linked them to their nearest secondary or tertiary hospital (CEmOC) via a communication system and a 24X7 ambulance stationed at the maternity hospital (BEmOC). Pregnant women directly visiting the CEmOCs who did not have any complications were referred to maternity hospitals for ANC registration and delivery. In cases of complication, patients were transported to the linked CEmOC. After this initiative, the number of registrations and deliveries conducted at the maternity hospitals increased and obstetric complication cases received timely specialist care (personal communication from expert in the Government of Delhi). This scheme worked because of active collaboration and geographical proximity of centres, which may not be as effective in several rural settings.

I did not find any research evidence on the efficacy of this scheme or similar schemes anywhere else in India.

v. Communication for institution referrals

Within the health system, most ANMs and staff at PHCs and CHCs have mobile phones and almost half PHCs and CHCs have computers.(51) The extent of communication between PHCs and CHCs or higher level centres for referral is not known. Such communications are not established at most levels, nor is the practice of providing referral slips or notes.(79, 80) Although the RCH guidelines recommend that health staff should provide a brief referral note, and if possible inform the higher level facility,(14) mostly they just give verbal instructions to the family of the patient.(36) Regarding transport, after the introduction of transport interventions there is some evidence that vehicles or ambulances are being arranged for transfers.(77)

Health staff should enquire about the availability of services and resources at the higher level before referring a case. Attempts are being made to standardise care at the centres, but until then the government will need to develop mechanisms to regularly update the staff at lower levels on the availability of services at the higher centre.

vi. Compliance by Patients

Compliance with institution referrals is not recorded routinely in the health system.(79, 81) A few studies have followed up referred cases and found that the compliance with referrals vary with perception of severity of complication, quality at the higher centre, distance, cost, and availability of transport.(56, 71, 74) Some patients with complications may prefer to go to private facilities. In Rajasthan, the presence of an accompanying person from the health staff or support at the referred institution improved

compliance.(82) ASHAs are advised to accompany the pregnant woman to the health facility for normal delivery or any complication.

3.3.4 Transport

The DLHS-III (2007-08) reported that 38% pregnant women used an ambulance, jeep or car and 7% used a motor cycle or scooter to reach a health facility. The majority of women (55%) used public transport and some even walked to health facility.(43) A study from Uttar Pradesh state showed that mothers who died were transferred between several facilities. Between one and nine hours were spent in shifting a case from one facility to another, and rarely anyone used ambulances.(37)

The '108' ambulance service (as described in section C) is functional across 22 states and reports suggest that '108' ambulances transfer 10-20% of all pregnant women.(40, 83) The '102' call centre based service focusses primarily on mothers and children.(41) Several regional and local tie-ups are also functional for improving transfer of women.(42) Most of these services transport all pregnant women in labour irrespective of any complication. The '108' service should also provide pre-hospital stabilising care during the transfer.

For institution referrals, one-half PHCs and 90% CHCs own vehicles that can be used for transfer of patients.(51) Health facilities can also use '108', '102', *CATs* or *Janani Express Yojana fo*r transfer to the next level. The '108', '102' and some local tie-ups are also being used to transport women back to home from health facility.(46) There is no comprehensive evidence on the use of these interventions for obstetric emergencies and inter-facility transfers.

These transport interventions provide free service to pregnant women. *Janani Suraksha Yojana* and *Janani Shishu Suraksha Karyakaram* beneficiaries also have a component of cash incentive for transport expenses. Some small level interventions in

Uttar Pradesh have voucher schemes to cover transportation costs. Still, average INR 270/- per pregnant woman was spent on transportation in 2007-08 (DLHS-III survey).(43) The extent of use of transport interventions may influence the population level averages.

3.3.5 Referral to and from the private health sector

The *Chiranjeevi* scheme in Gujarat is a public-private initiative under which empaneled private clinics provide basic and emergency obstetric care to the poor. A pregnant woman can be self-referred or referred by peripheral public health staff to any of these facilities.(29) In other states public health staff are encouraged to refer pregnant women to public institutions only, even if that facility is far. The '108' ambulances transfer patients to only a few empaneled private facilities if an appropriate public facility is not available in near vicinity.

Regarding referrals from the private sector, it is my opinion that private institutions refer the severely ill maternal cases to reputed Medical colleges to avoid any maternal deaths happening in their institution. This may be due to fear of enquiries and maternal death reviews, which bring unwanted attention and a bad reputation. Private hospitals may use their own ambulances or paid private ambulance service. '108' ambulance service transfers patients from private facilities only if they are transferred to public facilities.(83)

3.3.6 Monitoring and evaluation of referral systems for EmOC

There are no reports, or indicators, to assess the quality of decision making and management of institution referrals in India. Some audits look into the quality of antenatal and delivery care, and inappropriate referrals may present as a finding.(84) There is no structured documentation of out-referrals or in-referrals at the facilities, nor on outcomes of referral.

4 CONCLUSION

In response to the MDGs there has been an increase in institutional deliveries and improvements in infrastructural support in India. To further prevent maternal mortality and morbidity India needs to ensure that i) all those at risk, or having, complications should utilise EmOC services, ii) there is an efficient referral system to prevent delay in accessing care once in the health system, and iii) the quality of services at health facilities is adequate.

India is still in the process of upgrading its public sector EmOC services. It struggles with defining levels of care available and referral pathways. Nonetheless, the country has started referral transport interventions for pregnant women. Issues of non-utilisation of birthing centres, bypassing, inadequate referral, misdirected referral, unjustified referral, non-compliance, poor communication and poor quality of services at EmOC may affect outcomes of referral. There is no standard referral strategy for EmOC nor any monitoring system to assess referral mechanisms.

There are several knowledge gaps about referrals for obstetric care in India, such as i) the needs of the community with respect to care for high-risk, early complications, and emergencies in pregnancy, delivery and postpartum, ii) utilisation patterns of the existing facilities with respect to levels of obstetric care, iii) utilisation of transport interventions, iii) compliance to referral advice, iv) quality of referrals in terms of decision for referral, pre-referral stabilising care, pre-referral communication, and v) acceptance and care at the referral facility. Referral is a component of quality obstetric care and also depends on knowledge, skills and practices of health staff and inter-facility relationships. There is no current evidence on the quality of referral, especially for early complications in pregnancy and complications arising during delivery. There is an urgent need to generate evidence

on current referral practices for pregnant women in India. Following this, strategies need to be developed and interventions tested to improve obstetric outcomes of women and newborns.

5 RATIONALE FOR THIS RESEARCH

With increasing demand for institutional delivery in India, and in the absence of comprehensive emergency obstetric services at peripheral centres, there is an urgent need for strong referral systems to provide pregnant women who have complications or emergencies with adequate care. Without an efficient referral system, and an associated transport system for emergencies, India will not be able to achieve speedy reduction in MMR. The Indian health policy of 2002 (85) stated that there should be a clear referral system for complications in pregnancy and delivery. However, to date there has been no evaluation of the existence, quality and efficiency of referral pathways for emergency obstetric care in India. In addition, the transport interventions for obstetric emergencies and inter-facility transfers have not been evaluated, and their socio-demographic and geographic spread and efficiency are largely unknown.

The review of literature and programme documents suggests several gaps in the existing knowledge and understanding of aspects related to referral systems for high-risk, early complications and emergencies in pregnancy, delivery and post-partum. Thus, this study aims to describe the current referral pathways and transport services for pregnant women in India and identify strategies for strengthening referral systems for emergency obstetric care.

CHAPTER 3: AIM AND OBJECTIVES

1 AIM AND OBJECTIVES

Goal- To identify strategies for improving the referral systems for emergency obstetric care in India.

Aim – To study the public health referral systems and transportation for emergency obstetric care in India.

Objectives

1. To describe the key issues regarding referral pathways for emergency obstetric care in the public sector health systems in India: Critical review

Referral between health facilities for obstetric care

2. To summarise the evidence on the extent of referrals, and associated factors influencing referrals, within Indian public sector facilities for women at obstetric high-risk or with complications or emergencies: Systematic review
3. To assess the knowledge, attitudes and practices of staff at places of delivery about referrals to higher levels of care for women with obstetric high-risk, complications, or emergencies: Providers survey.

Transportation for pregnant women

4. To summarise the evidence on the effectiveness of transport interventions in emergency obstetric care in India: Systematic review
5. To describe the socio-demographic and clinical characteristics, and pregnancy outcomes, of pregnant women who called the '108' ambulance service for transport: Review of secondary data and, cross-sectional surveys of women who were transported and women who called the service but were not transported.

I will describe the findings and construct the discussion about referral systems and transportation for obstetric care in India to drive comprehensive conclusions.

2 LAYOUT FOR THE THESIS

This thesis is presented in the "book style" format, in accordance with the London School of Hygiene and Tropical Medicine research degree regulations. This thesis is divided into five sections (sections A to E). Each section is further sub-divided into chapters.

Section A- 'Introduction' has three chapters. *Chapter-1* provides introduction to the current knowledge and importance of referral systems for obstetric care across the world. The section also covers key terms and concepts that will be followed while conducting this research and interpreting the results. *Chapter-2* describes the status of obstetric care and public health systems in India. It also includes the critical review (objective 1) on aspects related to referral protocols and pathways for emergency obstetric care in public sector health systems in India. The findings from this chapter formed the base for devising specific objectives and methods for the main research work. *Chapter-3* describes the rationale, aims and objectives and layout of the thesis.

Section B- 'Referral between health facilities for obstetric care in India' focuses on pathways of inter-facility referrals and quality of these referrals. The section has two chapters. *Chapter-4* is a systematic review to estimate the proportion of referrals between public sector health institutions for women with obstetric high-risk, complications, or emergencies, and to summarise evidence on factors affecting the quality of referrals in India (objective 2). *Chapter-5* reports on findings from a KAP survey (objective 3). The study is a cross-sectional survey in two states of India to assess knowledge, attitudes and practices of ANMs and SBAs at peripheral places of delivery (CHC, PHC and SHCs)

regarding referrals (antenatal and during labour) to higher levels of care for women with obstetric high-risk, complications, or emergencies. The study explored the practices and confidence levels of care providers for most common obstetric high-risk, complications and emergencies, and the quality of care provided at the study centres. Some case scenarios were used to explore management and decision making in typical complication situations. The findings are discussed with respect to the capacity of the health centres.

Section C- 'Transport for obstetric care' covers both the transport from home to health facility and between facilities. The section has four chapters. *Chapter-6* is a systematic review on the effectiveness of various transport interventions in India to increase institutional delivery rates and reduce maternal mortality (objective 4). The review describes the key features of these interventions and summarises their achievements. *Chapter-7* describes the largest public sponsored privately managed emergency transport system which is a mainstay for transport for pregnant women in the country. The '108' ambulance system is used as a platform for the next study. *Chapter-8* is based on the *a*nalysis of '108' data from April 2013–March 2014 for six states (objective 5). The chapter explores the use of the '108' service specifically by women with obstetric emergencies and for transfer between facilities (Inter-facility transfers, IFTs). *Chapter-9* describes the telephone survey of callers to the '108' service and compares the characteristics of women who were transported using '108' and those who called '108' but were not transported. The study explores whether there is any discrimination in providing a '108' ambulance, and the pattern of use of the ambulance with respect to high-risk in pregnancy, early complication in pregnancy, obstetric emergency, type of health facility visited, and referrals.

Section D- 'Discussion, conclusions and recommendations' (*Chapter-10*) summarises all the research and presents a complete picture of current referral systems and transportation for obstetric care in the public health systems in India. The discussion highlights issues of concern, best practices, and implications of the findings in the context of other international and national evidence. Comprehensive conclusions are derived based on the discussion and recommendations made to improve the quality of referrals between facilities and increase use of the '108' ambulance service for obstetric high-risk, early complications and emergencies and inter-facility transfers.

Section E- 'Bibliography and Appendices' includes references to all the above sections and other information regarding the research- definition, search strategies, few result tables, research tools and published papers.

SECTION B

Referral between health facilities for obstetric care in India

Systematic review-4
Providers' KAP survey-5

CHAPTER 4: REFERRALS BETWEEN PUBLIC SECTOR HEALTH INSTITUTIONS FOR WOMEN WITH OBSTETRIC HIGH-RISK, COMPLICATIONS, OR EMERGENCIES IN INDIA – A SYSTEMATIC REVIEW

Published: Singh S, Doyle P, Campbell OM, Mathew M, Murthy GVS. (2016). Referrals between Public Sector Health Institutions for Women with Obstetric High-risk, Complications, or Emergencies in India – A Systematic Review. PloS ONE 11(8): e0159793. Doi:10.1371/journal.pone.0159793 (Paper-1, Annex-II)

1 INTRODUCTION

Most obstetric complications, except those abortion-related, occur during delivery or immediately after delivery, and they have the potential to rapidly become life threatening.(86) Many of these will require rapid referral to appropriate health facilities.(6, 8, 17, 87) Several interventions to improve referral systems have focused on improving self-referrals, with only a few on improvement of referrals between facilities, the number and quality of between-facility referrals, and transport for inter-facility transfers.(18)

My preliminary review of Indian health policies, reproductive health programme documents and interviews with state maternal health consultants, reported in Chapter 2, revealed that there are no published standard referral protocols for obstetric emergencies and complications in India. The SBA training manuals mention clinical criteria for referral, but these guidelines are not supported by appropriate resources in the health systems. Usually no records relating to referrals between facilities are kept, and no referral slips or communication about the referred case is provided to the next level facility.(79, 80) There

is no routine feedback mechanism or routine monitoring of the appropriateness of referrals in India.(80)

1.1 Rationale for Systematic review

There is a paucity of evidence from India on the proportion of complicated and emergency obstetric cases that are detected at the primary health institutions level and referred to appropriate higher level health institutions. This systematic review from India will help understand the existing referral criteria, referral pathways, factors affecting referrals and proportion of referrals for obstetric care across the country. With changing policies and interventions to strengthen EmOC it is necessary to understand the changes in referral systems over time and existing needs in India.

1.2 Research Question

What is the proportion of referrals between public health institutions for women with obstetric high-risk, complications, or emergencies in India?

Secondary question

What are the socio-economic and medical characteristics of women who are referred for obstetric causes, and what are the referral pathways utilised?

2 METHODS

The research obtained ethics approval from ethics committees of both LSHTM and IIPH-Hyderabad. (LSHTM Ethics Ref: 9613; IIPHH Ethics Ref: IIPHH/TRC/IEC/009/2014)

2.1 Working Definitions

An institution referral is when a client seeks care at a lower level health institution (basic birthing centre or BEmOC) and is referred onwards to a higher level institution (BEmOC or CEmOC) by health staff for specialist attention. The referral is made for reasons of a high-

risk pregnancy, complications during pregnancy and puerperium, or an emergency at any time in pregnancy and puerperium.

High-risk conditions in pregnancy constitute demographic or obstetric or medical conditions that could pose an elevated risk for occurrence of a complication in pregnancy. A complication in pregnancy refers to any medical complication that is developed or is complicated as a consequence of pregnancy during pregnancy, labour or child birth or after (within 42 days of termination of pregnancy). (Refer to Annex-1, table-34)

2.2 Search Strategy

The literature search was conducted using six mainstream databases (Medline, Embase, Popline, IMSEAR, Cochrane Central Register of Controlled Trials (CENTRAL) and CINAHL) and four other databases (WHO, UNICEF, UNFPA and Indian RCH repository). Grey literature sources, such as programme reports, were also used. The review was restricted to studies from India, published in English between 1994 and 2013. We chose 20 years period to capture the RCH-1 program through RCH-2 post NRHM.

The electronic search strategy was based on terms related to referral or emergency, and pregnancy, obstetric high-risk, obstetric complications, or obstetric emergencies, and India. Appropriate MeSH and/or keywords using respective thesauri were used. (Annex-III)

2.2.1 Inclusion criteria

i. All studies (hospital or community based) and reports with institution referrals for obstetric care, with any kind of epidemiological study design, were included. Studies reporting either in-referrals from lower-level institution or out-referrals to higher-level institution were included.

ii. Type of participants in the studies or reports: Studies with pregnant, post-abortion and post-partum women referred by staff from designated public health institutions to a higher level referral institution were included.

iii. Place of study: India

2.2.2 Exclusion criteria

i. Studies or reports on referrals for non-maternal conditions.

ii. Editorials, commentaries and letters.

2.3 Screening

Screening was done by two independent researchers (myself and MM) using the inclusion and exclusion criteria. Screening was first done based on titles and abstracts and then subsequently by reading full text. Disagreement between reviewers, was resolved by discussion and establishing consensus.

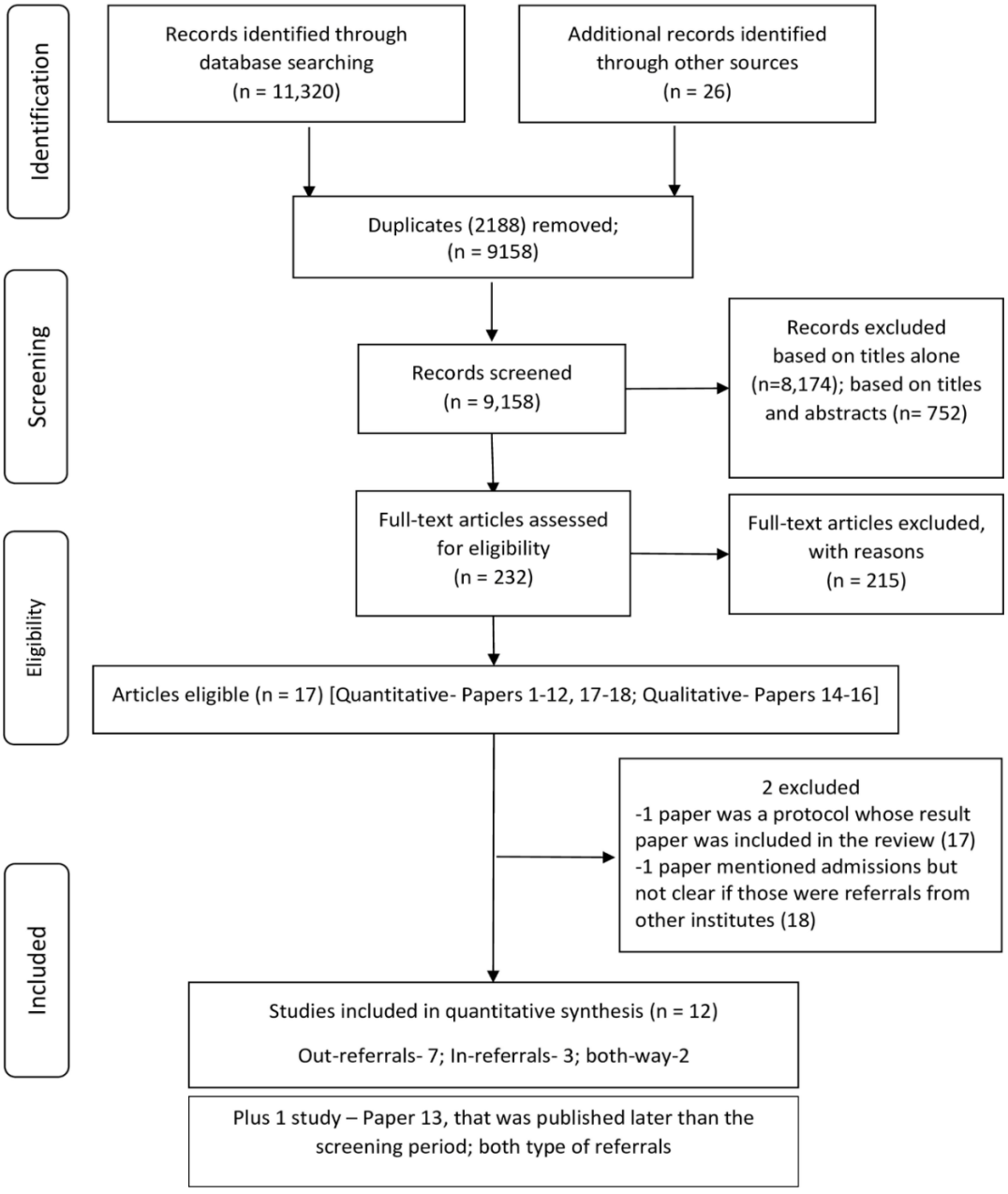
2.4 Data Collection

Measurement indicators studied were: the proportion of in-referrals and out-referrals; cause-specific referrals; place from where referred and the place referred to; pre-hospital treatment; availability and arrangements for transportation; type of transport and communication; costs and cash incentives; compliance rates, and socio-economic and medical characteristics of women referred. Data extraction forms were developed and piloted before use. Information was extracted on the type of intervention, if any, and the prevalence of outcomes and costs were considered. Key qualitative findings were also recorded and described.

The quality of papers was assessed using STROBE guidelines (88) for observational studies and CONSORT guidelines (89) for intervention studies. A score of 1 was assigned to each item in the checklist and a total score was calculated for each paper (maximum

score- STROBE=22; CONSORT=25). A score below 11 out of 22 for observational studies, and below 13 out of 25 for intervention studies, indicated poor quality. Potential risk of bias in methods (selection, performance and detection), analysis and reporting were assessed for each of the studies with respect to study designs. Reviewers also discussed the limitations in combining the results from different studies in the review.

Figure 4: Flow diagram for selection of studies in the systematic review on referral for obstetric care in India



2.5 Synthesis of results

Both quantitative and qualitative research studies were included. Each selected study was assessed with respect to the type of study and measurement indicators (proportions). Findings were summarised separately for a) abortion and post-abortion care, b) antenatal high-risk, and c) complications and emergencies any time during pregnancy and the puerperium. Qualitative studies were reviewed to provide supplementary information regarding institution referral rates, pathways and barriers to appropriate referral. The review was reported in line with the PRISMA checklist.(90)

3 RESULTS

3.1 Search results

The search yielded 11,346 articles from electronic searches and other sources (programme or project reports from specified organisational repositories) (figure-4). Duplicates (2,188) were removed before screening. A total of 9,158 articles and reports were screened for eligibility, of which 8,174 were excluded based on titles alone and 752 based on titles and abstracts. Reasons for exclusion were mainly that the studies were not from India, were not about pregnant women or pregnancy, or were editorials. A total of 232 articles and reports were selected, and full texts were read to assess for inclusion. Of these, 215 articles were excluded because they did not mention institution referral pathways or proportions of institution referrals. Finally, three qualitative articles and fifteen quantitative research articles were found eligible for inclusion.(33, 36, 56, 59, 69, 77-79, 81, 91-99) Of these, two articles were from the same study: one was a study protocol (69) whose subsequent article on results (95) was included for quantitative analysis. One article was further excluded at the time of data extraction.(99) Although this

article mentioned admissions in hospital as referrals, it could not be concluded if those were referrals from other institutions. One of the included studies was a baseline of a community based clinical trial. The paper on outcomes from this trial did not mention any referral intervention or results for institution referral, thus was not included in the review.(68) During the synthesis of results and reviewing new literature, researchers found one paper very relevant to the review but it was published in 2014 i.e. later than the search criteria of up to 2013.(78) It was decided to include this paper in the results.

3.2 Characteristics of included studies

3.2.1 Quantitative

Out of the thirteen studies, out-referrals from a health institution was documented in 7 (papers 1-3, 6-9, table-4), in-referrals to a health institution in 3 (papers 10-12, table-4) and both out-referrals from and in-referrals to a health institution were documented in 3 studies (papers 4, 5, 13, table-4). Among the 7 out-referral studies, five were prospective cohort studies following an intervention (without controls), one was a cluster randomised trial, and one a cross-sectional study. Two of the three studies that mentioned both-way referrals were prospective cohort studies following interventions and one was a cross-sectional study. All 3 in-referral studies were cross-sectional studies. One of these cross-sectional studies was only about abortions.(97) Characteristics of the studies are described in table-4.

3.2.2 Qualitative

Of the three studies (papers 14-16, table-4), one conducted in-depth reviews and focus group discussions and the other two conducted only in-depth interviews among the pregnant women and/or care takers. One study was only about abortions (paper 14, table-4). These studies were not scored on quality. However potential biases were identified.

3.2.3 Interventions

Five out of eight studies involving interventions focused on improving high-risk identification during antenatal care and referral by a medical officer, ANMs, Village health volunteers (VHWs) or traditional birth attendants (TBAs, also called *Dai locally*) (papers 1-4 and 8, table-4). Three studies also trained the ANMs, VHWs and TBAs for conducting safe deliveries, identification of complications and referrals (papers 3, 8 and 9, table-4). In two studies medical officers were trained for supervision of ANMs and VHWs. Only two studies focused on improving EmOC at primary level health institutions and referral to a higher level (papers 5 and 7, table-4). However, it should be noted that the institutions in these studies were primarily run by trained nurses and had an on-call medical officer or obstetrician available for opinion. In one study (paper 13, table-4) a cash incentive transfer scheme, the *Janani Suraksha Yojana*,(100) implemented by the government covered the availability and cost aspects of referral transport. The state government where this study was based also had *Janani Express Yojana*,(101) a system that transported pregnant women to health institutions.

3.2.4 Quality of included articles

Table-5 provides the scores of individual studies and summarises the potential biases as assessed by the reviewers. One paper (paper 1, table-5) was found to be of poor quality. Although most of the studies intended to improve or report referrals, they did not report results completely. It was difficult to ascertain if the referrals were due to high-risk or complications as no clear definitions were stated. Wherever the reasons for referral were described, we could appropriately classify them into high-risk or complications.

Table 4: Characteristics of studies included in the systematic review on institution referral for obstetric care in India

Sno	Author	Type of study	Time of study	State	Rural/ Urban	Type of institutions	Participants (N0.s)	Intervention
Out-referrals								
1	Maitra 1995 (79)	Intervention-Prospective Cohort [b]	1987-1990	Uttar Pradesh, Madhya Pradesh, Haryana, Rajasthan, Gujarat, Maharashtra	Rural	SHC and PHC	Antenatal women registered at SHC or PHC (12,907)	Training of community[d] for high-risk; Training of ANMs and MO for ANC, high-risk screening, referral and record keeping for referrals
2	Hitesh 1996 (56)	Intervention–Prospective Cohort [b]	1993	Rajasthan	Rural	SHC	Antenatal women in community (206)	Training of ANMs and TBAs for ANC, high-risk screening and referral. Red referral card was issued to refer women.
3	McCord 2001 (91)	Intervention–Prospective Cohort [b]	1996-1999	Maharashtra	Rural	Community and Private hospital	Antenatal women and women in labour in the community (2,905 pregnancies)	Training of community[d] via VHWs; Training of VHWs for ANC, high-risk screening, delivery care, complication identification and referral; low cost delivery and referral care at private hospital
4	Barua 2003[a] (92)	Intervention–Prospective Cohort [b]	1994-2001	Maharashtra	Rural	Community and PHC	Antenatal and postnatal women attending clinics (NA)	Training of ANMs for ANC, high-risk screening and referral to PHC, establishing ANC clinics to be run by ANMs, MOs of PHC trained for supervision and referral to DH.

Sno	Author	Type of study	Time of study	State	Rural/ Urban	Type of institutions	Participants (N0.s)	Intervention
5	Iyengar 2009[a] (77)	Intervention– Prospective Cohort [b]	2000-2008	Rajasthan	Rural	Equivalent to PHC run by NGO midwife / nurse	Antenatal, intra-natal and postnatal women attending at the health institution (2,771 deliveries + 400 in-referred complications)	Training of nurse midwifes at health institution for ANC, EmOC and referral in consultation with on-call obstetrician
6	More 2011 (93)	Cross-sectional	2005-2007	Maharashtra	Urban slums	Community	Pregnant women who delivered in the community (10,754)	-
7	David 2012 (59)	Intervention-Retrospective Cohort [b]	2005-2010	Tamil Nadu	Urban	UHC	Antenatal, intra-natal and post-natal women at the health institution (1,873 deliveries)	Training of 2 nurses at UHC for ANC, EmOC and referral in consultation with on-call family physician
8	Alehagen 2012 (94)	Intervention-Prospective Cohort [b]	2006-2009	Maharashtra	Rural	Community, SHC and PHC	Antenatal women and women in labour in the community (31,693 deliveries)	Training of community[d] for high-risk & complication via female health volunteers; Training of ANMs and TBAs for ANC, high-risk screening and referral; Training of ANMs and TBAs for safe delivery at home or PHC, complication identification and referral; Training of nurses and MO at PHC for supervision. Establishing 9 PHCs and 5 mobile clinics.

Sno	Author	Type of study	Time of study	State	Rural/ Urban	Type of institutions	Participants (N0.s)	Intervention
9	Pasha 2013 (95)	Cluster RCT	2009-2011	Maharashtra Karnataka	Rural	Community, PHCs and referral hospitals	Antenatal women and women in labour in the community (20,852 deliveries in Intervention; 18,551 in control)	Training of community[d] via community facilitators for high-risk, complication and birth preparedness; Training of community birth attendants (TBAs and ANMs) for home based life-saving skills and referral; Training of staff at health institution for EmOC facility improvement.
In-referrals								
10	Biswas 2004 (81)	Cross-sectional	1997-1998	West Bengal	Rural and Urban	First Referral units (FRUs) - Area and Rural hospitals	Pregnant women admitted for delivery (26,062)	-
11	Kaul 2006 (96)	Cross-sectional	2000-2003	Chandigarh	Rural and Urban	Tertiary hospital	Postnatal women who developed PPH at the hospital or admitted with PPH after delivery (178)	-
12	Banerjee 2012[c] (97)	Cross-sectional	2006	Madhya Pradesh	Rural and Urban	Secondary and Tertiary Hospital	Women seeking care for post abortion complications (786)	-

Sno	Author	Type of study	Time of study	State	Rural/ Urban	Type of institutions	Participants (N0.s)	Intervention
13	Chaturvedi 2014[a] (78)	Cross-sectional	2014	Madhya Pradesh	Rural and Urban	Secondary and Tertiary Hospital	Women seeking care for intra-natal care (1182)	Government of India managed *Janani Suraksha Yojana* which provides cash incentives to women delivering in institutions. Part of this incentive covers cash for transfers. Government of Madhya Pradesh also instituted *Janani Express Yojana* to provide vehicles for transfer of pregnant women to health institutions.
Qualitative								
14	Johnston 2003 (98)	Focus group discussions and In-depth interview	1999	Uttar Pradesh	Rural	Community	Men and women, women in reproductive age, post-abortion care providers	-
15	George 2007 (33)	In-depth interview	2004	Karnataka	Rural	Community	Pregnant women seeking delivery care	-
16	Vijayshree 2012 (36)	In-depth interview	2011	Karnataka	Rural	Not mentioned	Women seeking delivery care	-

[a]Both out and in- referrals; [b]No controls; [c]Abortions only ; [d]Community refers to the pregnant women and family members, and other women and stakeholders in the community

SHC= Sub –Centre ; PHC= Primary Health Centre ; UHC= Urban Health Centre; ANC= Antenatal care; MO= Medical officer; ANM= Auxillary nurse midwife; VHW= Village health volunteer; TBA= Traditional birth attendant

Table 5: Quality scores of (based on Strobe and Cochrane guidelines) and potential biases in studies included in systematic review on institution referrals

Sno	Author	Type of study	Scores based on STROBE/ CONSORT	Potential bias [a]
Out-referrals				
1	Maitra 1995 (79)	Intervention-Prospective Cohort [b]	10/ 22 Poor quality	Difficult to ascertain bias as the methods were not properly described. Results about timing and reasons for referral were also not clearly mentioned.
2	Hitesh 1996 (56)	Intervention–Prospective Cohort [b]	15/ 22 Medium quality	Reporting bias: The details about when (during antenatal, intra-natal or post-natal period) the pregnant women were referred were not provided. Difficult to differentiate between referrals for high-risk or complications.
3	McCord 2001 (91)	Intervention–Prospective Cohort [b]	20/ 22 High quality	-
4	Barua 2003[a] (92)	Intervention–Prospective Cohort [b]	15/ 22 Medium quality	Difficult to ascertain bias. Methods for baseline survey and facility survey not elaborated. Methods of surveillance and record keeping not mentioned.
5	Iyengar 2009[a] (77)	Intervention–Prospective Cohort [b]	19/ 22 High quality	Reporting bias: The details (outcomes or referral) of the cases managed by the visiting obstetrician were not mentioned. Overall referral rates for the institution may be different.
6	More 2011 (93)	Cross-sectional	19/ 22 High quality	Study is a baseline before a trial. Performance bias: Data collection was spread over two years during which some interventions had started. This could have led to contamination and influenced the outcomes. Reporting bias: The details about when (during antenatal, intra-natal or post-natal period) the pregnant women experienced the reported complaints and

Sno	Author	Type of study	Scores based on STROBE/ CONSORT	Potential bias [a]
				were referred were not provided. Place of birth and pregnancy outcomes not mentioned. Detection bias: Symptoms that are unrecognised, not thought to be serious or considered normal may lead to under reporting and limited care-seeking
7	David 2012 (59)	Intervention-Retrospective Cohort [b]	17/ 22 Medium quality	Reporting bias: High-risk pregnancies identified during ANC were referred to higher level health care and their deliveries were not attempted at the institution. The paper doesn't report these numbers.
8	Alehagen 2012 (94)	Intervention–Prospective Cohort [b]	15/ 22 Medium quality	Study was not planned as pre-post intervention study. Difficult to ascertain bias as the methods of data collection are not elaborated. The baseline was assessed by a survey while the follow up data collection/ recording and frequency of recording is not described.
9	Pasha 2013 (95)	Cluster RCT [c]	20/ 25 High quality	Performance bias: Intervention could not be completely implemented. Blinding could not be done. Reporting bias: Referral related process indicators were not reported.
In-referrals				
10	Biswas 2004 (81)	Cross-sectional	18/ 22 High quality	Detection bias: The data were extracted from hospital records of past years. The quality of recording and diagnostic criteria may have varied over time. Reporting bias: Reference period was not mentioned thus it was difficult to assess referral rates over time.
11	Kaul 2006 (96)	Cross-sectional	17/ 22 Medium quality	Detection bias: The data was extracted from hospital records of past 4 years. The diagnostic criteria of post-partum haemorrhage for deliveries in the study hospital may vary from the referred cases whose deliveries were outside the

Sno	Author	Type of study	Scores based on STROBE/ CONSORT	Potential bias [a]
				study hospital. The later cases were also by selection more likely to be in moribund state due to time lost in travel and seeking care.
12	Banerjee 2012[c] (97)	Cross-sectional	19/ 22 High quality	Detection bias: Symptoms of complications of abortions were self-reported and may vary in perception of relevance and seriousness.
13	Chaturvedi 2014[a] (78)	Cross-sectional	20/22 High quality	Performance bias: Data collection was spread over one year but only 5 days in each of the 96 institutions. Five days of recruitment is a short period to comment on functioning and referral of an institution. Institution may try to perform better during the study period. Reporting bias: The health institution were referred as primary, secondary and tertiary. It was not clear if primary level institutions were just basic birthing centres or BEmOC. Similarly, were the secondary level institutions providing all BEmOC functions or were CEmOC? This makes it difficult to assess the referral quality in review of obstetric emergencies.
Qualitative				
14	Johnston 2003 (98)	FGDs and In-depth interview	-	-
15	George 2007 (33)	In-depth interview	-	Not planned as a scientific study. During a big study, 12 women seeking emergency obstetric care were impromptu followed and interviewed.
16	Vijayshree 2012 (36)	In-depth interview	-	Difficult to ascertain bias. Source of sample and detail methods of data collection and analysis not mentioned.

[a] Taxonomy based on risk of Bias from Cochrane Handbook; [b]No controls; [c]Consort

3.3 Out-referrals

Table-6 summarises the findings on out-referrals. The relevant articles are discussed below.

3.3.1 Referrals for abortion and post-abortion care

No article found

3.3.2 Referrals for high-risk pregnancy

Three articles exclusively report on high-risk screening in pregnancy and out-referrals by community health staff or staff within a SHC.(79, 92, 94) All the three studies involved training ANMs for high-risk identification and referral to a higher level (PHC or Public Rural Hospital). The other 6 studies on out-referrals report on both high-risk cases and complications in pregnancy.(56, 59, 77, 91, 93, 95) However these did not report the proportion referred for high-risk in pregnancy. These are covered in the next section on complications in pregnancy.

i. Proportion of out-referrals

Maitra (79) reported that 4,522 (35%) pregnancies in rural areas of 6 states were identified as being at high-risk out of the total registered pregnancies (12,907). Only 786 (18%) of the high-risk pregnancies (i.e. 6% of all the pregnancies) were referred after intervention. However, this paper scored poor on quality. Barua (92) also reported that after intervention, SHC ANMs found 35%-37% of registered pregnancies in rural areas in Maharashtra at high-risk and they referred them all to PHC medical officers. When anaemia and short-stature were excluded from these referrals then referrals to the PHC medical officer were only 18%. Alehgen (94) reported an increase from 25% cases identified and referred for high-risk in 2006 to 52% in 2009 out of an estimated population of approximately 7,000 deliveries in a year in rural areas of Maharashtra.

Table 6: Summary findings of institution out-referrals for abortion, high-risk pregnancy, or complications in pregnancy/delivery (systematic review)

Out-referrals for reasons	Percentage of cases identified out of all pregnancies, %	Percentage of all pregnancies referred, %	Percentage compliance out of all referred, %	Second referral to higher institution, %
Abortion*	-	-	-	-
Antenatal high-risk				
Sub-health centre/ community to PHC/ other institution				
Maitra, 1995 (79)	35	6	52.9	
Barua, 2003 (92)	35-37	35-37	-	
Aleghan, 2012 (94)	25-52	25-52	-	
Complication or Emergency				
Sub-health centre/ community to PHC/ other institution (BEmOC or CEmOC)				
Hitesh, 1996 (56)	-	-	10.2	
Mc Cord, 2001 (91)	-	-	-	4.7
Pasha, 2013 (95)	-	-	-	-
Nurse run health centre or PHC (BEmOC) to First referral unit (FRU)/ CEmOC				
Iyengar, 2009 (77) (All pregnancies in any phase of pregnancy)	26.1	19.7	67	-
David, 2012 (59) (Low-risk pregnancies for delivery care)	36.3	36.3	68.6	-
Chaturvedi,2014 (78)		14.3		
Doctor run health centre (BEmOC) to higher institution (CEmOC)				
More, 2011 (93)	-	2	-	-
Chaturvedi, 2014 (78)		7.5		

*cases of spontaneous abortions and post-induced abortion complication would have presented as complications in pregnancy

In the Maitra and Barua studies, medical officers within the PHC further referred critical high-risk cases elsewhere for delivery (numbers and type of severity not reported).(79, 92)

ii. Medical reasons for referrals

Pre-eclampsia was detected in 11% and severe anaemia in 8% of all pregnant women in the study by Alehgen in 2012.(94)

iii. Institution referral pathway and compliance

During the baseline survey, Maitra, 1995 (79) and Barua, 2003 (92) noted that there were no referral records and no mechanisms whatsoever for identifying high-risk pregnancies before the intervention was implemented. These articles do not mention the type and quality of referral records that were maintained during the intervention.

Alehgen, 2012 (94) realised that the limited skills of available nurses and medical officers, and the high turn-over of staff, were limitations in establishing nurse-based ANC care. The study at baseline found that ANMs lacked equipment, skills and confidence to screen for high-risk, provide treatment, and refer appropriately. Similarly, PHC medical officers lacked the skills and confidence to manage high-risk cases. As part of the intervention SHC ANMs and PHC medical officers were trained for their respective roles. Referrals were to be made to the next level of available public health institution. However, there was no reporting of results, including whether any pregnant women were referred to a private health institution or if they complied with the choice of suggested referral institution. It is interesting to note that between 1995 and 2012 there was little improvement in high-risk screening and referral.(79, 92, 94)

In the study by Maitra in 1995,(79) most of the referrals made by the field workers were to a SHC. About half (53%) the women with high-risk complied with referral.

3.3.3 Referrals for complications or emergency in pregnancy or puerperium

Six articles reported out-referrals for complications in pregnancy.(56, 59, 77, 91, 93, 95)

Two qualitative articles provide patient experiences of referrals for complications.(33, 36)

i. Proportion of out-referrals

Community health staff/ SHC to PHC/ BEmOC: In three studies (56, 91, 95) the intervention involved strengthening the skills of ANMs, TBAs or their equivalent in the community for ANC care, delivery care and referral. One of these studies (95) also provided training for home based life-saving skills to stabilise patients before referral. None of these studies report the proportion of high-risk or complication cases referred by these nurses to health institution.

Nurse run health centre (equivalent to PHC) / BEmOC to first referral unit (FRU) / CEmOC: One study in a rural area in Rajasthan by Iyengar, 2009 (77) and another in urban slums in Tamil Nadu by David, 2012 (59) attempted to strengthen the skills of nurses at the health centres (equivalent to PHC) to provide BEmOC services and referral under the mentorship of a visiting obstetrician (77) or physician.(59) The nurses in both studies did not induce labour in the absence of a doctor. In the first study 2,771 women presented in labour of whom 446 (16%) were referred to FRU.(77) The second study based in urban slums referred all the high-risk pregnancies to the next level of care and only attempted to assist 1,873 low-risk pregnancies during the study period. Of these, 679 (36%) were referred to a higher level for delivery and one post-partum hemorrhage case (out of 7) for treatment.

Mc-Cord in 2001 (91) reported that 20 (5%) of 425 pregnant women from a rural study population in Maharashtra who attended the FRU were referred further onward for advanced specialist care. A study in urban slums in Maharashtra in 2011 (93) reported that less than 2% clients who sought care for any high-risk or complications at either public or private providers were referred to another health institution. The study also reports that as this urban population had access to range of health institutions, the community

itself took efficient decisions on where to go based on their perceived severity of the symptoms and thus they may not have required further institution referral.

Chaturvedi in 2014 (78) studied all the levels of health institutions which were assisting at least 10 deliveries in a month in 3 districts of Madhya Pradesh. Except PHCs, all other institutions had 24X7 medical officers available. The study reported that 5.9% of 1182 women seeking delivery care were referred out. The out-referral rate was highest from PHCs (14%) followed by CHCs (8%) and tertiary hospitals (1%). Half of the referrals from PHC were directly to tertiary hospitals, bypassing the CHCs.

ii. Medical reasons for referrals

Among all the deliveries attempted or complications occurring at a nurse based rural health centre in Rajasthan, common reasons for referral were obstructed labour (25%), antepartum haemorrhage (16%), pregnancy induced hypertension (16%), severe anaemia (14%), complicated abortion (12%), post-partum haemorrhage (6%) and twin pregnancy (6%).(56) Among low-risk deliveries conducted at the nurse-based urban health centre, common reasons for referral were premature rupture of membranes (20%), failure to progress (15%), foetal distress (9%), pregnancy induced hypertension (10%), post-date pregnancies (6%) and grade-III meconium (6%) in early labour.(59)

About two-fifths of the referrals from PHCs (43%) and three-fifths from CHCs (59%) in Madhya Pradesh were for prolonged labour and premature rupture of membranes followed by haemorrhage (10% in PHC and 7% in CHC) and eclampsia (3% in PHC and 7% in CHC). It is interesting to note that about 7% of referrals were due to facility dysfunction i.e. non-availability of staff, power or water.(78)

iii. Institution referral pathway and compliance

In a 1996 study investigating the role of training, Hitesh reported that 206 women were issued a red referral card for high-risk or complications in 12 SHCs.(56) Of these, only 21 (10.2%) made any attempt to go to next level of health care. In the study in urban slums by David in 2012, 68.6% of referred women complied with referral,(59) while in the study in rural areas by Iyengar in 2009, 74% of referred women complied.(77) Both the studies provided accompanying persons when required. Providers in the later study also arranged for transportation. Fixed rate private jeeps were available for transfer and for poor patients, nurses arranged transport for free or for subsidised rates.

Hitesh found that the most common (overlapping) reasons mentioned for non-compliance were cost (100%), lack of follow-up after reaching the institution (92%), TBA advised against it (92%), non-availability of transport (79%), previous bad experience (75%) and patients considering their symptoms normal (61%).(56) Iyengar found that compliance was higher when complications occurred before the baby was born (79%), compared to those that occurred after delivery or abortion (57%).(77) Patients with ante-partum haemorrhage and severe anaemia were difficult to convince about their need for referral. They tended to be apprehensive that relatives would be asked to donate blood.(77)

3.3.4 Qualitative studies

The study by George et al in 2007 (33) reported case studies of 12 rural pregnant women in Karnataka who were seeking care for complications in pregnancy. These case studies highlighted that despite repeated visits to the public and private health care providers, patients did not obtain the required emergency obstetric care. The main reason identified was poor service delivery. The health systems had weak information systems, there was

no continuity of care from antenatal to delivery and postpartum, peripheral health workers were unsupported and did not have the required skills, and there were haphazard referral systems and distorted accountability mechanisms when adverse events occurred.(33) Nine of the twelve women under study died despite seeking care in time.

Another study in Karnataka in 2012 of 10 users of EmOC services showed that these pregnant women received appropriate antenatal care but were not confident of where and when to get the EmOC services.(36) The designated FRU's (CEmOC) had not been able to ensure 24 hour services every day of the week. All these women were living below the poverty line and belonged to scheduled castes or tribes. The six pregnant women with bad outcomes had gone through several referrals both in public and private health institutions. This was mostly due to non-availability of resources at the time of their visit. There was a time lapse of 10 hours to 32 hours to receive the required level of EmOC and there was a tendency to refer women at high-risk, or with complications, for the fear of facing maternal death audits and blame. The four women who had good outcomes received EmOC care due to interventions of caste-based organisations, local practitioners or concerned unions.(36)

3.4 In-referrals

3.4.1 Referrals for abortion and post-abortion care

Only one paper on in-referrals by Banarjee, 2012 (97) reported on referral related to abortion and complications of abortions.

i. Proportion of in-referrals

A total of 381 cases with complications after induced abortion and 405 after spontaneous abortion were interviewed. Eighty eight percent of the induced abortion group and 20%

of the spontaneous abortion group had visited at least one institution before coming to the study hospitals.(97)

Among the induced abortion group, 27 (7%) came directly to the study hospitals for inducing an abortion, 10 (5%) tried induction of abortion at home then came directly, 273 (72%) visited one health institution, 59 (12%) visited 2 institutions and 12 (3%) visited 3 institutions before coming to one of the study hospitals. Among the spontaneous abortion group 327 (80%) came directly to study hospitals and the rest 78 (20%) visited one health institution before coming to the study hospitals.

ii. Medical reasons for referrals

The paper mentions the self-reported symptoms but nothing about specific reasons for institution referral.

iii. Institution referral pathway and compliance

Most of the women were not aware if the health providers they visited were qualified or not.(97) A qualitative paper by Johnston, 2003 (98) interviewing post-abortion care providers in study villages in rural Uttar Pradesh revealed that pregnant women consulted the local village-level providers for abortion care rather than going to the nearest health institution. Village-level providers were all un-qualified practitioners, however the pregnant women thought they were qualified. These village-level providers tended to provide abortion and post-abortion care rather than refer to more appropriate providers. If the case was critical they would refer the case to the nearest town, however no specific health institution was mentioned.

3.4.2 Referrals for High-risk in pregnancy

No article found

3.4.3 Referrals for complications or emergency in pregnancy or puerperium

Three articles reported in-referrals for complications in pregnancy.(78, 81, 96)

i. Proportion of in-referrals

Biswas in 2004 (59) reported that on an average 5-10% of all in-patients at FRUs in West Bengal were in-referrals from peripheral health institutions (estimate as told by the head of institutions). In a tertiary hospital in Haryana, Kaul in 2006 (96) reported that 90 (0.6%) of 13,907 deliveries developed post-partum haemorrhage and another 88 PPH cases were referred in after having delivered elsewhere. Nineteen women (11%) suffered "near-miss" morbidity (5 in hospital delivery and 14 referred cases).

Chaturvedi in 2014 (78) found that 111 (9%) of 1,182 women seeking delivery care were referred in from other institutions. None of the cases referred in by other institutions required to be referred out again. The proportion of in-referrals was highest in government tertiary institutions (21%) followed by private hospitals (16%), both of which were working as CEmOCs. CHCs which were working as BEmOCs received only 1.6% in-referrals. It is important to note that the average number of women in labour per institution was 121 for tertiary institutions, 21 for CHCs, 6 for private hospitals and 4 for PHCs over a five day period.(78)

ii. Medical reasons for referrals

Not specified

iii. Institution referral pathway and compliance

Kaul found that 54 (61%) of 88 referred PPH cases were transferred in more than 6 hours after delivery elsewhere. All 14 near-miss cases in the referred group reached the tertiary hospital more than 6 hours following delivery.(96) In Madhya Pradesh, 63% in-referrals used a *Janani Express Yojana* vehicle. The average inter-institution travel time was 1.25

hours.(78) About three-quarters (72%) in-referred cases had a referral slip however they mostly did not contain the reasons for referral and the treatment provided before referral.(78) The superintendents of FRUs (96) stated that there were no records for in-referrals at any FRU and only 2 out of 12 FRU studied had some records for out-referrals. The in-referred cases did not carry referral notes, and there were no mechanisms for providing feedback to referring units.

A recent study in 2014 reported that 97% of referrals were before delivery, and 60% were admitted at the first institution before referral. Most of the first referrals were received at government tertiary care centres (73%), followed by private hospitals (15.3%) and CHCs (12%). The former two worked as CEmOCs, and the CHCs were mostly BEmOCs. Most of the first referrals at tertiary care centres were received from CHCs (65%) and PHCs (25%). Most of the first referrals at private care centres were from CHCs (71%) and remaining were from other private hospitals. None of the referrals from PHCs were received in private hospital. There were 13 second referrals, received at government tertiary care centres and private hospitals.(78)

Table-7 summarises the problem issues in referral of obstetric cases.

Table 7: Problem issues identified in institution referrals for obstetric high-risk or complications (systematic review)

Obstetric care and the proportion of referrals
1. High proportion of referrals from the peripheral health institutions.
2. Low skills and confidence of peripheral staff in identifying high-risk and complications and providing stabilising care.
Classification of high-risk pregnancy or complications in pregnancy
3. Confusion in the clinical criteria for referral: Some high-risk cases can be managed at BEmOC and may not need referral. Only the complication cases need to be referred. Clear definitions for referral criteria can help decide for appropriate referrals and avoid unnecessary referrals.
4. No standard guidelines for the management of high-risk conditions and complications at BEmOC. This could avoid unnecessary referrals.
5. Low confidence of nursing staff at basic birthing centres and PHCs to manage high-risk pregnancies and to induce labour despite the SBA trainings, established referral linkages and transportation services.
Reaching appropriate referral facility
6. Bypassing CHCs: PHCs prefer to refer straight to district level secondary and tertiary care centres. This may be due to lack of information at SHCs and PHCs about services available at mid-level institutions (CHC).
7. Non- uniform standards and availability of care despite defining an institution as PHC or CHC or BEmOC or CEmOC.
8. No transport interventions specifically for referrals between institutions.
Quality of referral
9. No emphasis on the quality of referral advice, referral notes and keeping referral records.
10. No formal communication and transportation arrangements between the institutions.
11. No audit on quality of antenatal and delivery care including referral from the peripheral centres.
12. Poor compliance: Need for complications awareness and readiness in the community, and emphasis on referral counselling.

4 DISCUSSIONS

4.1 Level of obstetric care and proportion of referrals

This review suggests that about one-third to half of pregnancies in rural populations are assessed as high-risk and are referred from a SHC to a PHC or CHC for further antenatal check-up and delivery care (table-6). Almost half of these are anaemia or short stature cases which add large numbers to the high-risk obstetric population in India.

Simultaneously, low-risk pregnant women delivering at nurse run PHCs or Urban centres, which are capable of providing BEmOC care (except induction of labour), refer up to one-fifth to one-third of cases to a higher level institution. These findings suggest that about half to two-thirds of all pregnant women attending lower level health institutions are likely to be referred during pregnancy or delivery (table-6). Studies in Africa suggested similar proportions. If protocols for antenatal high-risk identification and referral, along with referral for complications, are followed then 35-50% of pregnant women in Africa will need to be referred from peripheral institutions to the next level of care.(102)

Two studies also found that, ANMs, nurses and even doctors were not confident and did not have skills to provide EmOC and referral care.(94, 103) The under-confident and unskilled health staff are likely to refer higher proportions of pregnant women on the slightest of indication of high-risk or complication. The selected intervention studies in this review did not have pre-intervention proportions and comparison groups to ascertain above hypothesis.

4.2 Referral for high-risk in pregnancy or complication in pregnancy

A study conducted in Tanzania in 2009 reported that 28% of women registered for ANC at peripheral health centre were referred to higher level hospitals. Out of the referred patients, 70% were referred due to demographic risks, 12% due to obstetric historical risks, 12% with prenatal complications and 5.5% with delivery and immediate postnatal complications. Only half of these referred women complied, and these were mainly women with obstetric historical risks and any complications.(104) The proportion of referrals in this study are lower than nurse-run centres in our review, probably because the centre in the Tanzanian study was run by a clinical doctor. A clinical doctor or a medical

officer is likely to be more capable of managing obstetric high-risk and complications as compared to the nurses, thus reducing the number of referrals to next level. One study in our review (78) suggested that 14% women were referred from a PHC and about 8% from CHC for delivery complications alone compared to 6% in the Tanzanian study. The commonest causes for referral were prolonged labour and rupture of membranes which could have –in theory- been managed at the referring institutions.(78) This suggests that there is tendency for over and unnecessary referral from peripheral institutions in the government sector.

We also observed that definitions of high-risk and complications and referral indications were not uniform in the studies. The studies prior to 2000 focused primarily on high-risk screening during antenatal care by ANM, VHWs or TBAs while in the later studies the focus was also on delivery services, identification of historic obstetric high-risks and complications, and referral from primary care institutions. It appears that antenatal high-risk identification and referral still continues although the Safe Motherhood strategies now emphasise providing basic natal care to all with early identification of obstetric complications and providing referral to appropriate EmOC care.(105) Decisions about referrals are often very complicated and confusing in the absence of guidelines.

Studies show that high-risk prediction may not necessarily mean that the woman will have complication and many women identified as being at risk go on to have normal deliveries.(106, 107) Jahn and De Brouwere identified a core set of indications for referral which would produce referral rates of 6% to 10% and reduce a lot of un-necessary high-risk referrals. These include mainly previous caesarean section, breech presentation, transverse lie, multiple gestation, hypertension, and severe anaemia.(17) One of the

community-based studies in the review found that only 14% of all deliveries had any complications,(91) and another study by Bang et al found that only 18% had any complications.(65) This suggests that if all the deliveries were to be managed at a functional BEmOC (capable of managing high-risk) then there may not be high proportion of referrals to CEmOC.

4.3 Reaching an appropriate referral institution for high-risk, complication or emergency

Findings of qualitative studies in the review suggest that referrals are haphazard and a pregnant woman at high-risk or with complications did not get the required EmOC and had to go through several referrals before reaching the appropriate institution. The high proportion of referrals and the experiences faced during referral are probably a reason why pregnant women in India choose to deliver at private institutions or go directly to higher level government institutions to avoid the transfers.(94, 103)

A study by Chaturvedi in 2014 suggests that referrals from PHCs were justified, however 69% were directly to more trusted tertiary care bypassing the CHCs. About half the referrals from CHCs could have been managed at the CHC. Bypassing CHCs by the PHC, and unjustified referrals from CHC, point towards distrust and lack of confidence in CHCs for the management of complications. Interestingly, none of the in-referrals in any of the institutions in this study required to be referred further. Only 7% referrals had either two or three referrals.(78)

Although many interventions have been implemented in India in the last decade for the transportation of pregnant women there are no interventions specifically for referrals between institutions.(100, 101) Most PHCs and CHCs do not have their own ambulances

and rely on services like '108' ambulances or other public private transports for transfers.(37)

Assessment of CEmOCs in various states of India have shown that the number of complicated deliveries handled at referral institutions is far below the estimated need of around 15% of all pregnancies and 100% of all complications.(81, 108, 109) Despite of high proportion of referrals from lower institutions the referrals received at higher institutions for complications is highly inadequate. This may be due to poor compliance to referral or referrals are mostly for non-complicated high-risk pregnancies or normal deliveries. A study in Tanzania suggested that only 1% of referrals to a referral institution were for any complication or emergency. Amongst the rest, 18% were high-risk cases referred during the antenatal care.(16)

4.4 Quality of referral

Studies in our review also reported that there were no referral records maintained and no proper referral documents provided to the pregnant women at the time of referral. Only in one study 73% of referrals were provided referral slips but they did not provide any information about clinical manifestations or treatment.(78) Studies in the review found that the complication cases were not adequately stabilised nor were they given first-line treatment before referral, and a large proportion did not comply with the referral at all. A few chose to go to their preferred institution. This may be due to poor communication and counselling skills of the sender, high cost, non-availability of transport and distrust in the referral institution. Compliance was better in the presence of an accompanier from the referring institution or where the nurse arranged for the transport and communicated about the case to the higher level institution.(8)

India has a '108' free ambulance service in most parts of the country which is the mainstay for transfer from home and between institutions for pregnant women.(83) However, a study in Gujarat on referral systems and transportation revealed that the focus of the system was more on the number of ambulances and drivers, and less on the number of referrals transported.(80) In Madhya Pradesh 63% of the referred cases used a *Janani Express Yojana* vehicle and average travel time was 1.25 hours between institutions. The study identified that factors contributing to poor quality of referral and delay in getting care were less about the availability of transport, than inadequacies of the staff in identification of complications, referral and communication with the nearest appropriate institution and provision of pre-transfer first-line treatment. The study also identified delays in receiving care at the referral institution.(78)

There was overall lack of monitoring of the referral system and accountability to patients. Murray et.al (15) recommends supervision and increasing accountability of care providers. Strand et.al (110) and Konganyuy et.al (111) suggest audits of referrals for obstetric emergencies to improve referral systems for obstetric care and prevent delays.

Three phases of delay regarding access to appropriate emergency obstetric care have been identified: Phase I delay caused by time spent in decision making; phase II delay resulting from time spent reaching an appropriate institution for care; and phase III delay caused by waiting for appropriate care after reaching an appropriate centre.(10) Inefficient institution referral systems contribute mostly to phase II delays but may also contribute to phase III delays due to non-readiness of the hospital because of poor communication about the arrival. Misdirected referral may also lead to phase II delays by sending the patient to an institution which is incapable of managing the referred condition. This may even increase the severity of the complication in due course.(18) On

the other hand unjustified referrals may lead to underutilisation of some centres and overcrowding at others.(16) Further research is required to understand the determinants of each of these components in Indian context.

A critical review on maternity referral systems, mainly institution referrals, in developing countries found that there was considerable disparity between the hierarchical referral pyramid found in policy documents and the realities for women to access maternity care in many urban and rural settings.(15) Successful implementation of each referral system needs a referral strategy informed by the assessment of population needs and health systems capabilities, an adequately equipped referral institution, specific referral protocols, active collaboration between referral levels and other sectors, established communication and transport arrangements, affordable service costs, supervision and accountability for quality of care, the capacity to monitor effectiveness and policy support.(15)

4.5 Strengths and Limitations

The systematic review is first of its kind to summarise evidence on referrals across different levels of care and for different indications in obstetric care in India. Restricting the review to India helped to understand referral criteria and pathways in the context of Indian health systems. The review emphasises the need for development of clear referral protocols, and for the resources to implement them. The findings from the review will help the programmers to have an estimate of referrals and also to identify future intervention research.

A few studies identified in this literature search were not included as they did not clearly mention if the participants were self-referrals or institution referrals. A few others did not mention results appropriately on proportions of referrals and causes of referrals.

These studies, if reported well, could have added more evidence. Among the selected studies on out-referrals, the outcomes of pregnancy in terms of maternal and newborn morbidity and mortality and modes of transport and costs were not well reported. Thus we could not link the referrals with these variables. Most of the studies on out-referrals used interventions to improve referrals and did not report pre-intervention referral proportions or have controls. It was thus difficult to combine results of the intervention and cross-sectional studies.

4.6 Conclusions

The proportion of institution referrals was high. Referrals are a huge burden on the Indian health systems, especially regarding transportation and management at higher institutions. Along with this, poor referrals may contribute to phase II and phase III delays. The high proportion of institution referrals and pathways of referrals in India point towards a) the inability of PHCs to provide basic delivery care and BEmOC services, b) inadequate pre-referral stabilising care, c) a tendency for unjustified referrals to higher institutions, d) bypassing the CHCs as first referral choice, e) inadequate referral communication and record maintenance, and f) absence of standard guidelines for referral, facilities and monitoring of referrals for obstetric care.

Studies are required to assess the referral practices and problems faced by staff at lower level health institutions to decide when, where and how to refer the pregnant women. Strategies need to be developed a) to provide supervision and support to nurses for better BEmOC and referral, b) to standardise treatment and referral protocols and pathways, and c) monitor the quality of obstetric care and referrals made and receiving these referrals at higher institution.

CHAPTER 5: KNOWLEDGE, ATTITUDES AND PRACTICES OF STAFF AT PLACES OF DELIVERY ABOUT REFERRALS TO HIGHER LEVELS OF CARE FOR WOMEN WITH OBSTETRIC HIGH-RISK, COMPLICATIONS, OR EMERGENCIES

1 INTRODUCTION

In 2016, WHO launched standards for improving the quality of maternal and newborn care in health facilities, including childbirth (20) and antenatal care.(19) The document recommends early assessment for high-risk and complications in pregnancy in order to provide appropriate care during childbirth. The success of any emergency care depends on timely life-saving interventions supported by functional referral to ensure access to higher level care when required.(112) Health workers, especially from settings that have poor referral linkages, should be highly competent in risk prevention, risk assessment, stabilisation of complication case, and making arrangements for transfer and care at the referral level.(12, 113) In low resource settings, referral may also be needed during the antenatal period for routine investigations available only at higher centre (eg. ultrasonography, thyroid test), and as well as for uncomplicated facility delivery where basic resources are not available at lower centres.(114)

As mentioned in Chapter 4, studies are required to assess the referral practices and problems faced by staff at lower level health institutions to decide when, where and how to refer the pregnant women. There is little evidence from India on the perspectives of health care providers at peripheral centres about the referral of high-risk and complications during labour. Even fewer studies focus on the quality of antenatal care for screening, management, and referral for high-risk and early complications in pregnancy.

Thus this study was planned to assess the knowledge, attitudes and practices of health care providers at peripheral places of delivery about referrals to higher levels of care for i) women with obstetric high-risk and early complications in the antenatal period, and ii) women with obstetric high-risk and complications during labour, in two states of India.

2 METHODS

2.1 Study design

A cross-sectional survey was conducted on knowledge, attitudes and practices (KAP) of obstetric health care providers in peripheral health centres in two Indian states. The study was supplemented by a facility survey and case studies.

2.2 Study area

The study was conducted in 2 states, Andhra Pradesh and Himachal Pradesh, in India. Andhra Pradesh (undivided)[9] is in the South of India and has better maternal health indicators, while Himachal Pradesh is in the North and has poorer maternal health indicators compared to country's average.

2.3 Study population

We studied health staff at public sector outreach centres (SHCs), basic birthing centres (PHCs) and BEmOCs (CHCs). The staff included doctors, obstetricians if available, staff nurses and ANMs.

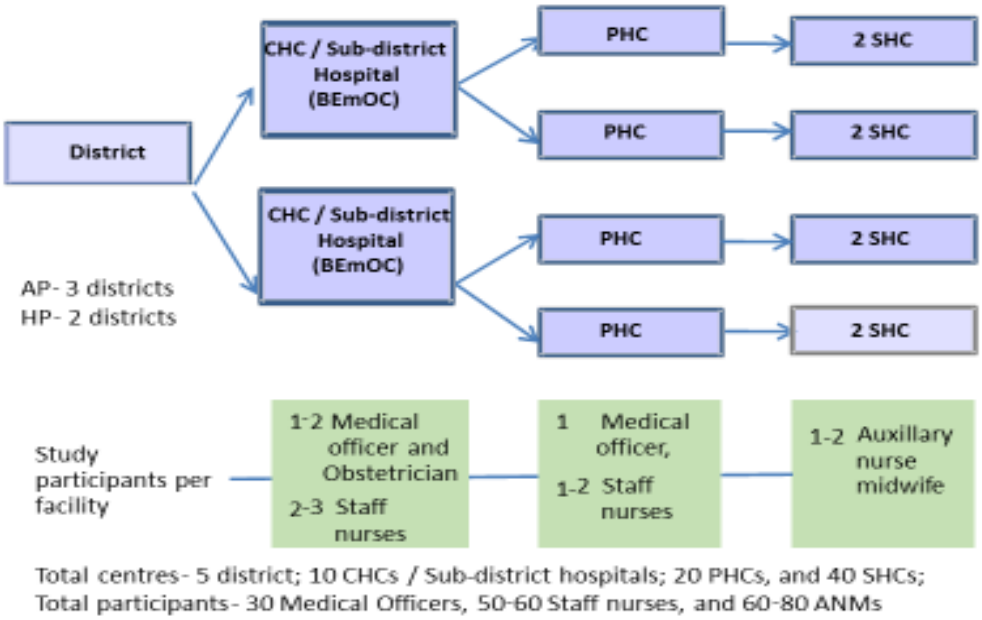
[9] Andhra Pardesh was divided in to two states, Telangana and (new) Andhra Pradesh in June 2014. At the time of sampling the state was undivided and thus districts were selected from (undivided) Andhra Pradesh.

2.4 Sampling

Across the districts, we planned to sample 10 CHCs, 20 PHCs and 40 SHCs. Two stage sampling was used to i) select five districts and then ii) select health facilities within the districts (figure-5). Details of sampling methods are given below.

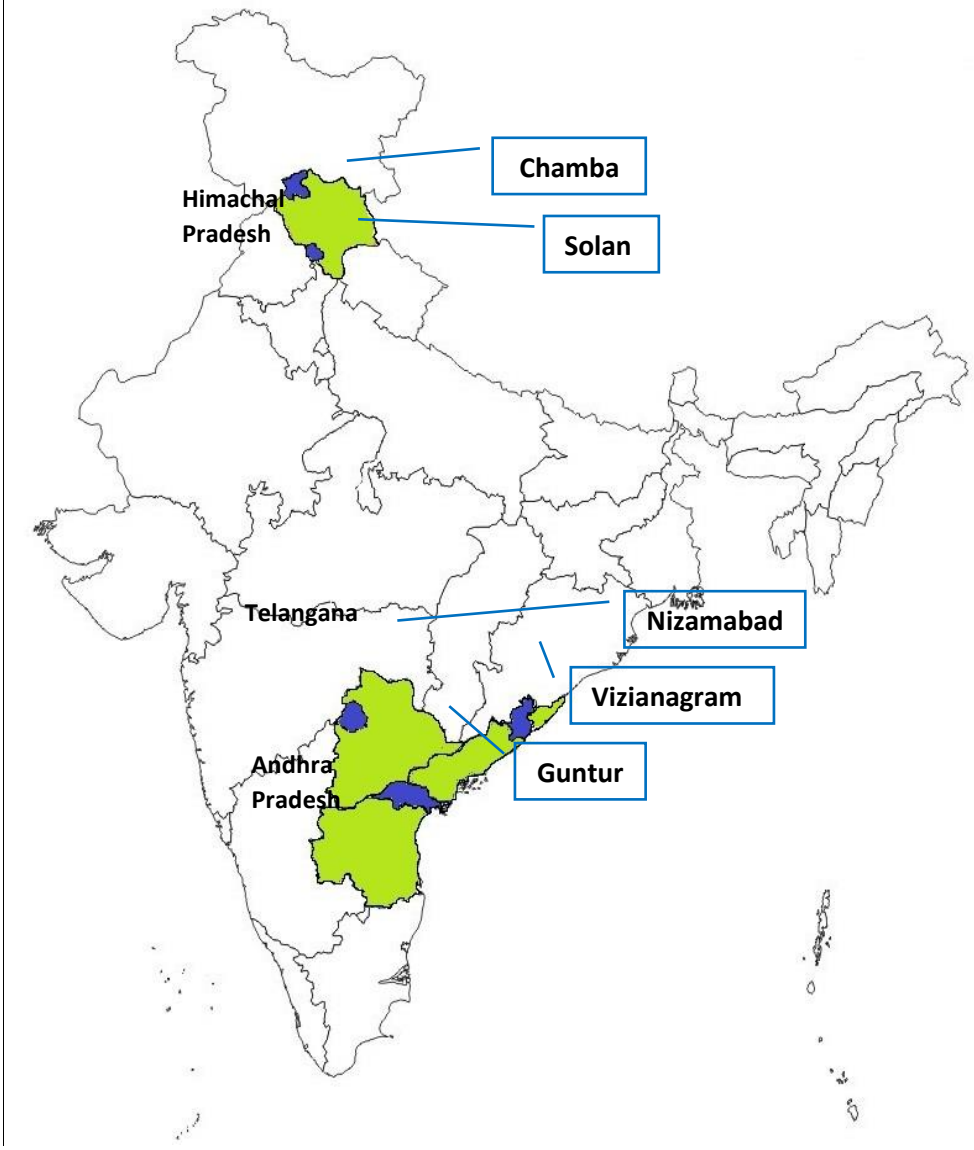
In 2012-13, the RMNCH+A programme ranked all the districts in each of the states with respect to key maternal and child health indicators.(38) This ranking was used to stratify the districts. We randomly selected one district from each stratum. Three districts were selected from Andhra Pradesh (undivided): one poor performing (Vijaynagram), one average performing (Nizamabad), and one good performing (Guntur). Two districts were selected from HP: one poor performing (Chamba) and one good performing (Solan) (figure-6).

Figure 5: Plan for sampling of facilities and health staff within the facilities for providers' KAP survey.



In Andhra Pradesh (undivided), two CHCs working as BEmOCs were randomly selected from each of the three chosen districts. Per CHC area, we selected two PHCs that were providing birthing services. We observed that sometimes only two PHCs provided birthing services in the selected CHC area. In one of the chosen CHC areas, only one PHC provided birthing services. In this CHC area, we randomly selected the second PHC from the remaining centres. We randomly selected two SHCs per chosen PHC.

Figure 6: States and districts included for providers' KAP survey



In Himachal Pradesh, after visiting the chosen districts, we found that birthing services were available at less than half of the CHCs and very few PHCs. A large proportion of BEmOC care was provided through Sub-district hospitals. Thus, in each district we randomly selected two Sub-district hospitals. For each Sub-district hospital, we selected two CHCs or PHCs that provided birthing services. We randomly selected two SHCs per chosen CHC or PHC. In HP, we additionally selected three PHCs that only provided antenatal care as they represented larger pool of PHCs. In both the states, a few delivery points had SHCs attached in the same building where ANM supervisors were posted. These were considered in the list of associated SHCs for sampling.

Selection of health centres was done in the presence of the respective District Health and Medical Officer (Andhra Pradesh) or Chief Medical Officer (Himachal Pradesh). With their permission and through their office, selected centres were pre-informed about the visit and staff presence was requested. We included all the doctors and staff nurses posted in labour rooms at PHCs and small CHCs. In Sub-district hospitals or big CHCs, where there were more than two staff nurses, we included the two present in the labour room during the day of our visit.

We visited 34 delivery points and 40 SHCs, and interviewed 31 doctors (including 4 obstetricians), 53 staff nurses and 63 ANMs across the two states (table-8). There were no ANMs posted for delivery points but there were ANM supervisors and ANMs in attached SHCs. There were no doctors and staff nurses for SHCs. There were no refusals.

Table 8: Sampled facilities and staff interviewed during the KAP survey across two states

		Type of health centre, N			Designation of participant, N		
State	District	Sub-district hospital /CHC	PHC	SHCs	Medical doctor & obstetrician	Staff nurse	ANMs
Andhra Pradesh*	Vizianagram	3	4	8	5	12	16
	Guntur	2	4	8	6	12	15
	Nizamabad	2	4	8	6	12	16
Himachal Pradesh	Chamba	3	4	7	7	10	7
	Solan	5	3	9	7	7	9
Total		15	19	40	31	53	63

*Undivided Andhra Pradesh

2.5 Data collection

The study was conceptualized by me and I played a leading role in the development and validation of tools, interviews, analysis and documenting the findings. I could not speak the local language in one of the states, thus I used help of a researcher to translate the questionnaires into the local language and back translate them. I conducted all the interviews with the doctors and about two-thirds of the interviews with nurses and ANMs. The remaining interviews were conducted by the researcher, supervised my me.

Data were collected for knowledge, attitudes and practices of staff, and facilities provided, at the health centres.

2.5.1 Knowledge, attitude and practices of staff

Interviews with health personnel were conducted using a semi-quantitative questionnaire. The questionnaires were based on the protocols described in the Government of India manual for SBA. The questionnaires were translated into local languages and pre-tested before use. The questionnaire in English is presented in Annex-IV.

Knowledge, attitudes and practices of health staff were assessed for screening and referral for high-risk and early complications in pregnancy, and complications and emergency at the time of labour. Scenarios with common obstetric ailments were used to test the ability of staff to diagnose the case, and to assess the treatment to be provided for stabilisation and decisions regarding referral. Administrative processes followed for referrals were measured. SBA training status and training needs relating to management and referral of common obstetric cases were also measured. We also asked two open questions, i) If the health staff faced any problems in referral of pregnant women and, if yes, what these were, and ii) What support they needed from the health systems to improve the quality of referrals for pregnant women.

2.5.2 Facility survey

The level of obstetric care at delivery points could not be assessed before sampling or data collection. Thus, we decided to do brief facility surveys at the chosen health centres. For facility surveys we used checklists based on Indian Public Health Standards (50) and services provided for the level of health centre with respect to emergency obstetric care.(8, 115) These included services provided to diagnose, stabilise, and manage obstetric cases and newborns at the health facility. We found that as per State policy, SHCs were neither promoted nor provided infrastructure for delivery care, so we did not do facility surveys in SHCs.

2.5.3 General observations and case studies

We made several observations during informal interviews with state administrators and centre heads and formal interviews with the study participants. We also observed a small sample of patients being provided care during our visit and developed case stories for some of these observed patients. There was no devised research plan for these

observations, but we made use of the opportunity of our visit to observe general functioning in the facilities and record details wherever a mother delivered in our presence.

Ethics approval for the study was obtained from London School of Hygiene and Tropical Medicine and Indian Institute of Public Health-Hyderabad. (LSHTM Ethics Ref: 9613; IIPHH Ethics Ref: IIPHH/TRC/IEC/009/2014) All the eligible staff provided written consent to participate in the survey.

2.6 Analysis plan

Data were recorded on MS excel and inspected for completeness and consistency. The profile of respondents was summarised. Responses to questions relating to knowledge, attitudes and practices of health staff are presented as percentages. The results are presented separately by level of health centre, as well as by antenatal care and care during labour. Information relating to facility surveys were described separately for CHCs and PHCs.

The observational (non-survey) information from providers and patients, and case-studies, are presented at appropriate places in the results section along with the quantitative results. The case studies and the brief observations are presented in Annex-Va and Vb respectively.

3 RESULTS

3.1 Profile of study districts

The information below was gathered through interviews with district officials and data from the DLHS-4 survey.

Vizianagram is a North-east district of Andhra Pradesh with tribal pockets which are not accessible during heavy rains. Referral health facilities in the difficult terrains are being upgraded. ANMs are promoted to assist low-risk deliveries in the SHCs in hard to reach areas.

Guntur is centrally located and has well maintained link roads. It has several government and private referral health facilities. Three-fifths women of Guntur deliver in private health facilities (table-9).

In Nizamabad from the state of Telangana, most parts of the district had access to Sub-district hospitals and to the District hospital, however resources and infrastructure were sub-optimal. The district also had three-fifths of women delivering in private facilities. More than half women in Nizamabad delivered by caesarian section (table-9).

Chamba, a North-west district of Himachal Pradesh state, has poor maternal health indicators (table-9). It has a difficult terrain and parts of the district are not accessible after snowfall in winters. We could not reach one of the CHCs due to blocked roads. Generally, it took about two hours or more to go from one valley to another, and to the district centre. Many health centres thus referred cases to accessible health centres in neighbouring districts rather than their own district. A few centres did not have access to any referral centre in winter.

Solan district is in the South of the state and is close to two big capital cities, Shimla and Chandigarh. Most parts of the district have access to Civil hospitals and to the referral hospitals in Solan, Shimla and Chandigarh. Inner valleys in the district however have poor access, and with the poor condition of the roads it can take one to one-half hours for referred cases to reach referral centres.

Table 9: Maternal health indicators in the study states and districts from DLHS-4, %

	Andhra Pradesh	*Vizia-nagram*	*Guntur*	Telangana	*Nizama-bad*	Himachal Pradesh	*Chamba*	*Solan*
Full ANC check-up	43	51	42	40	46	41	29	51
Institutional delivery	89	93	92	94	95	78	58	78
Government	39	52	29	32	35	66	55	66
Private	50	41	63	62	61	12	3	12
Caesarean section	33	30	34	52	54	11	6	14
Government	8	6	6	10	7	7	4	7
Private	25	24	28	42	46	4	1	7
Unmet contraceptive need	16	11	13	23	24	21	22	17

3.2 Characteristics of participants

The characteristics of participating staff from each type of health centre are described in table-10. We interviewed 35 doctors and staff nurses from CHCs and 49 from PHCs, and 63 ANMs from SHCs. Staff from CHCs and PHCs had an average 10 years of experience while those from SHCs had average of 15 years of experience. A large proportion of staff in PHCs (78%) received the SBA training, with less in CHCs (68%) and the lowest proportion in SHCs (50%). With respect to designation, 87% of the staff nurses were SBA trained while a lower proportion of doctors (58%) and ANMs (50%) were SBA trained. The staff received SBA training on average 2.3 to 3.7 years back. One-third of staff at CHCs and two-fifths from PHCs were trained to use the Safe Childbirth Checklist. All of these were from Andhra Pradesh and were trained under the *Dakshata* programme for quality improvement. Those trained are likely to be better informed about the management of complications and referral practices.

Doctors reported that the majority of their deliveries were assisted by staff nurses and the doctor was called for help in cases of complications in the mother or newborn. On

several occasions advice by phone was enough to support staff nurses in the management of the delivery case. At some health centres in Himachal Pradesh, trained *Dais* (traditional birth attendants, TBAs) assisted deliveries under the supervision of staff nurses and doctors. In the past six months, the staff nurses at CHCs assisted a median 30 (IQR, 20-50) deliveries and at PHCs a median 33 (IQR, 20-52) deliveries. ANMs assisted a median 4 (IQR, 0-8) deliveries either at the SHC or at home (table-10) in the past 6 months. Staff from Himachal Pradesh mentioned that antenatal check-up was mostly done by ANM supervisors at CHCs and PHCs. If the antenatal women required higher care or special investigations, then ANMs referred the women to consult the doctor at a PHC or CHC.

Table 10: Characteristics of health staff who participated in the KAP survey

	Sub-district hospital /CHC N=35	PHC N=49	SHC N=63
Designation of participants, (%)			
Doctor	13 (37)	18 (36)	0
Staff nurse	22 (63)	31 (63)	0
ANM	0	0	63 (100)
Mean years of experience (S.E.)	10.4 (7.9-12.9)	9.5 (7.5-11.5)	14.5 (12.3-16.7)
Mean years of service in current centre (S.E.)	5.0 (3.6-6.3)	4.3 (3.4-5.1)	7.2 (5.7-8.6)
SBA trained, (%)	23 (66)	38 (78)	31 (49)
Doctor*	7 (54)	11 (61)	-
Staff nurse*	16 (73)	27 (87)	-
ANM*	-	-	31 (49)
Mean years since SBA training (S.E.)	2.3 (1.6-3.1)	3.1 (2.1-4.0)	3.7 (3.8-7.7)
Trained for Safe Childbirth Checklist, (%)	12 (34)	22 (45)	9 (14)
Doctor*	4 (31)	8 (44)	-
Staff nurse*	8 (36)	14 (45)	-
ANM*	-	-	9 (14)
Number of deliveries assisted/ supervised in past 6 months; median (IQR)	32 (20-60)	28 (20-40)	4 (0-8)
Doctor**	50 (25-80)	28 (3-60)	-
Staff nurse	30 (20-50)	33 (20-52)	-
ANM	-	-	4 (0-8)

* Percentage out of number of participants with type of designation

**Doctors mostly did not assist deliveries but reported the deliveries they supervised directly or over phone.

The following results are presented separately for antenatal care and care during labour.

3.3 Antenatal care

3.3.1 Knowledge of screening and referral for high-risk and early complications in the antenatal period

Staff enumerated several high-risk and early complications that should be screened for in antenatal women (figure-7a and 7c), and that should be referred on from their health centre to a higher centre during the antenatal period (figure-7b and 7d). These were unprompted responses.

i. High-risk in pregnancy

Between half and three-quarters of the staff mentioned screening for history of caesarian section and history of abortion/stillbirth/preterm. Multiple foetus and abnormal lie of the foetus were less frequently mentioned. In general, a higher proportion of ANMs at SHCs enumerated the high-risk in pregnancy for screening compared to doctors and staff nurses at PHCs and CHCs (figure-7a).

Less than a quarter staff at CHCs while most staff at SHCs mentioned referring antenatal women for any high-risk. Almost half of the staff at PHCs said they referred women with previous caesarean section and previous abortion/preterm birth/stillbirth (figure-7b).

ii. Early complications in pregnancy

Almost all staff knew about the need to screen for high blood pressure and anaemia in antenatal women. Between half and three-quarters of the staff mentioned eclampsia/convulsions, bleeding in pregnancy, diabetes/thyroid disease, swelling in feet, foetal distress and HIV positivity as conditions to be screened for. The distribution was similar across the CHCs, PHCs and SHCs (figure-7c).

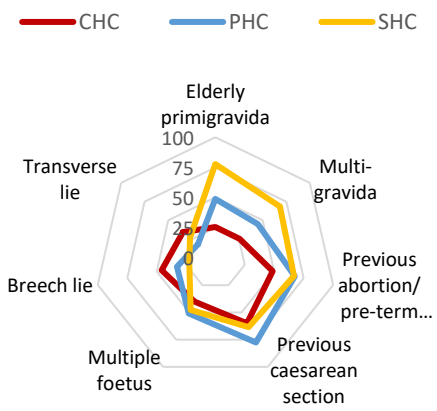
Almost all the staff said they would refer antenatal women with severe anaemia and high blood pressure. Foetal distress was the least mentioned condition. Other early

complications were mentioned only by a quarter to half of the staff. Staff from all three types of centres mentioned similar referral indications (figure-7d).

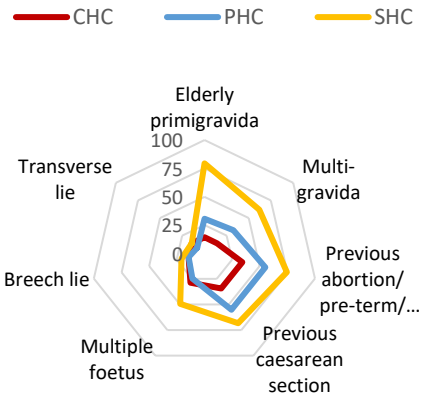
Compared to Andhra Pradesh, a higher proportion of ANMs from Himachal Pradesh mentioned various high-risks and early complications to be screened and referred (data not shown).

Figure 7: Knowledge about high-risk and early complications in antenatal period to be screened and referred out, among health staff working at CHC/PHC/SHC, %

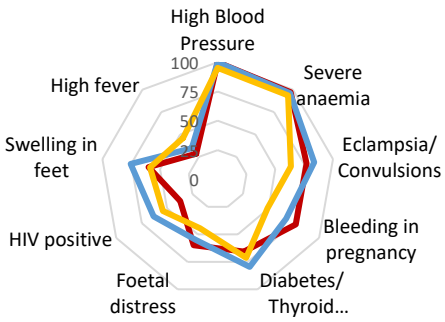
a) High-risk to be screened



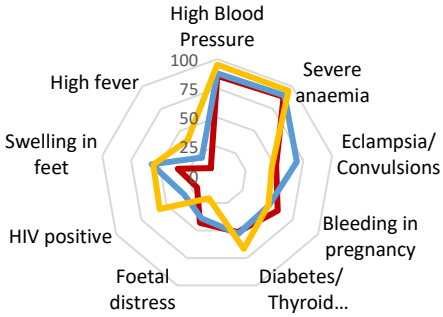
b) High-risk to be referred out



c) Early complications to be screened



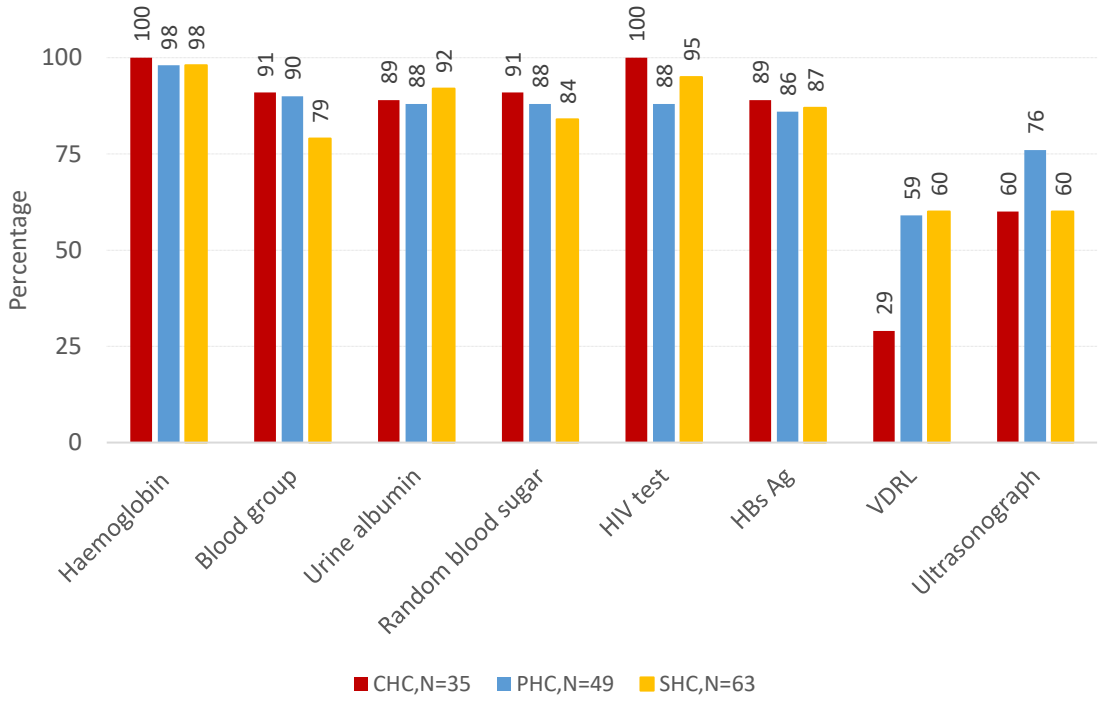
d) Early complications to be referred out



3.3.2 Investigations suggested for antenatal women

Figure-8 shows the list of investigations that were suggested for antenatal women at the respective health centres. These were unprompted responses. Almost all staff listed blood haemoglobin levels, and approximately 90% enumerated blood grouping, urine albumin, random blood sugar, HIV and HbsAg tests. Ultrasonography (USG) of the abdomen was listed by about three-quarters and VDRL (test for syphilis) by half of the staff. These proportions were slightly lower in ANMs at SHCs. None of the staff mentioned tests for thyroid hormones, thalassemia and TORCH, which are routine in tertiary hospitals.

Figure 8: Investigations suggested for antenatal care by health staff working at CHC/PHC/SHC



CHCs and PHCs did not have facilities for some, while SHCs did not have facilities for most, of these investigations. Staff advised the antenatal women to get these

investigations from higher health centres where the services were available. The staff stated that they filled forms and wrote referral slips for the required investigations.

The staff mentioned that women from Andhra Pradesh mostly went to private facilities for these investigations while most women in Himachal Pradesh got the suggested antenatal investigations from higher government facilities. In Himachal Pradesh they mentioned that, by government order, referral for antenatal investigations are well established. The women could visit a Sub-district hospital or District hospital to get USG, VDRL test, HIV test, and other sophisticated tests.

3.3.3 Practice in management of high-risk and early complications in the antenatal period

We enquired about the most common high-risk and early complications in pregnancy (figure-9a), and if the staff would- i) manage both the ANC and delivery, ii) manage the ANC but refer for delivery and, iii) refer for higher level antenatal care. The staff were asked specifically about each condition in turn.

i. High-risk pregnancy (Figure-9a)

More than three-quarters staff at CHCs and almost half at PHCs said they managed ANC and deliveries for elderly primigravida, multigravida and previous abortion/stillbirth/preterm birth. While if the women had a multiple foetus or abnormal lie of the foetus, half of the staff at CHCs and three-quarters at PHCs would continue ANC care but refer for delivery. ANMs at SHCs reported that they managed most of the high-risk and referred only for delivery.

ii. Early complications in pregnancy (Figure-9a)

More than half the staff at CHCs said they managed both the ANC and delivery in cases of milder conditions such as swelling in feet, high fever, and also high blood pressure. Staff

at PHC managed both ANC and delivery only for high fever. Almost half of the staff at CHCs and PHCs would refer antenatal women for higher care in cases of eclampsia, bleeding in pregnancy, diabetes/thyroid disease, and foetal distress. Women with HIV were referred for higher antenatal care by less than a quarter staff at CHCs and PHCs.

At SHCs, ANMs said they managed ANC for most early complications and referred only for delivery. Referral for higher level ANC care from SHCs was much less than expected given that SHCs don't have facilities to manage such cases.

3.3.4 Attitude towards management of high-risk and early complications in the antenatal period

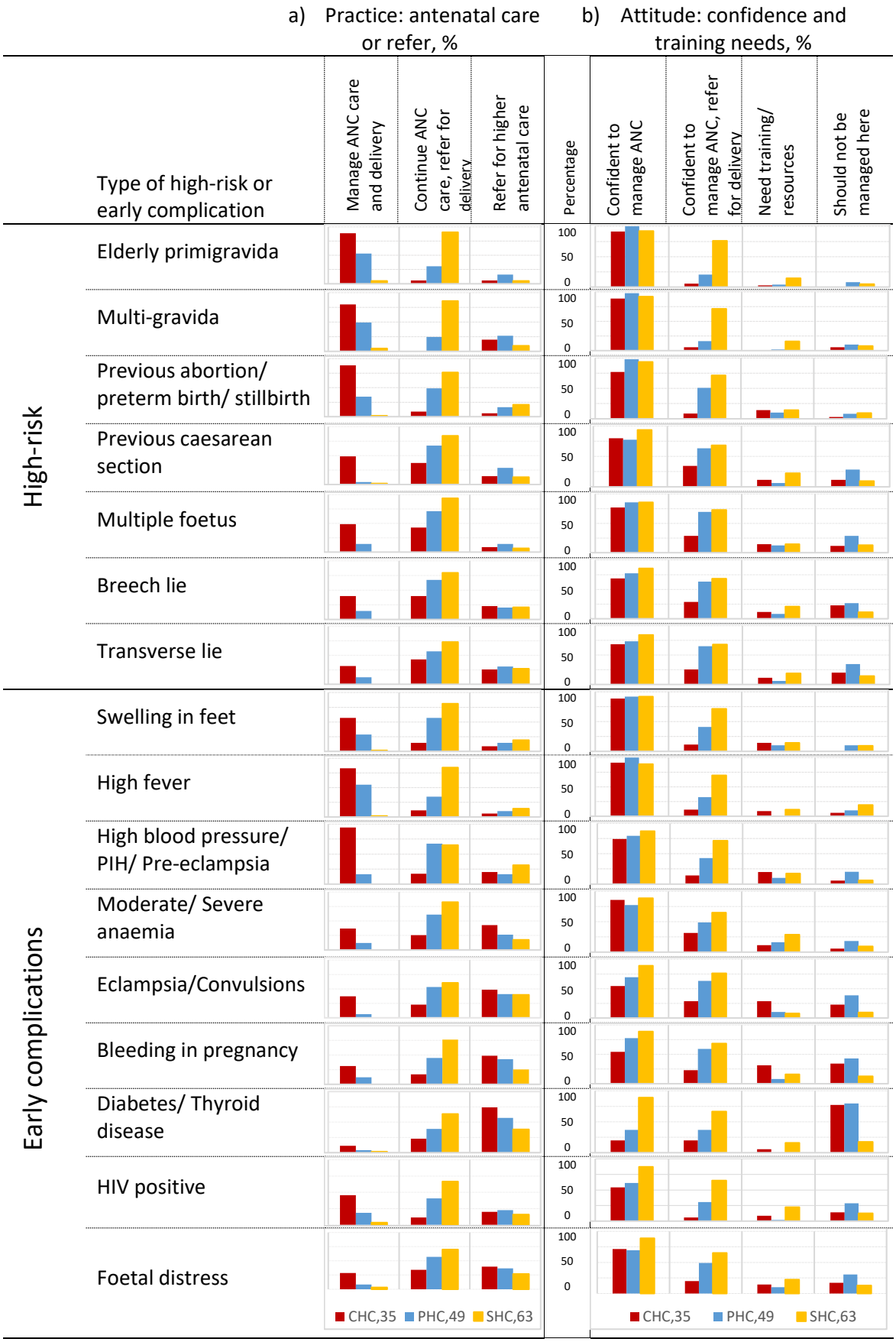
We also enquired about the confidence and needs of training/resources for the most common high-risk and early complications (figure-9b). A large proportion of staff from all centres were confident to manage antenatal care and responses mostly corresponded to the reported practice followed (figure-9a).

i. High-risk pregnancy (Figure-9b)

Most of the staff at CHCs, PHCs and SHCs were confident to manage ANC for high-risk pregnancies. However, the confidence level for assisting delivery was lower. Only a quarter staff at CHCs, but more than half of staff at PHCs, would refer a woman for delivery if she had a previous caesarean section, multiple foetus or abnormal lie of foetus.

Roughly a quarter of staff at PHCs mentioned that ANC care for women with previous caesarean section, multiple foetus or abnormal lie of foetus should not be provided at their centre. Staff suggested the pregnant women with high-risk conditions should register at higher centres where they would go for delivery.

Figure 9: Practice and attitude regarding high-risk or early complication in pregnancy. Data presented as proportion of staff at CHC/PHC/SHC responding yes to each question.



ii. Early complications in pregnancy (Figure-9b)

More than three-quarters staff were confident to manage ANC in cases of swelling in feet, high fever and high blood pressure, moderate to severe anaemia and foetal distress. However, confidence to manage delivery in such cases was lower among staff from PHCs and lowest from SHCs. Only half of staff at CHCs were confident to manage antenatal care for women with eclampsia, bleeding in pregnancy, and HIV positivity. A very small proportion were confident to manage cases of diabetes or thyroid disease. Compared to CHCs, a higher proportion of staff from PHCs and SHCs felt confident to manage medical complications in the antenatal period, however a higher proportion would refer such women for delivery to higher centres.

Roughly a quarter staff at CHCs expressed a need for training or extra resources to be able to manage women with high blood pressure, eclampsia and bleeding in pregnancy. A few from PHCs and SHCs asked for training to manage women with swelling in feet, high blood pressure and anaemia. Three-quarters staff at CHCs and PHCs felt that antenatal women with diabetes or thyroid disease should not be managed at their centres. A quarter at CHCs also mentioned bleeding in pregnancy and a quarter staff at PHCs mentioned that eclampsia, bleeding in pregnancy, HIV positive and foetal distress should not be managed at their centres.

We observed that understanding of antenatal management varied across centres. ANMs at SHCs considered management to include screening for high-risk and early complication, referral when appropriate, and continuing to provide basic antenatal care throughout pregnancy. Staff nurses and doctors at PHCs and CHCs understood that providing treatment for early complications or stabilising care before referral is also part of management.

3.3.5 Management of specific antenatal case scenarios

The case scenarios and the management as told by the staff is summarised in figure-10.

i. Moderate anaemia in 2nd trimester (Figure-10a)

All the staff across all the centres diagnosed moderate anaemia correctly and more than 80% prescribed oral iron and Folic-acid tablets (100 mg) twice in a day. Almost half the staff in CHCs and one-thirds in PHCs prescribed injectable iron for management. Injectable iron was mentioned less often by the staff from Himachal Pradesh. Half the staff from all the centres also mentioned that they would refer the women for higher care. Although Mebendazole tablets and nutrition advice is recommended in the RCH programme a negligible number of staff mentioned these, while six staff suggested blood transfusion.

ii. Pregnancy induced hypertension in 3rd trimester (Figure-10b)

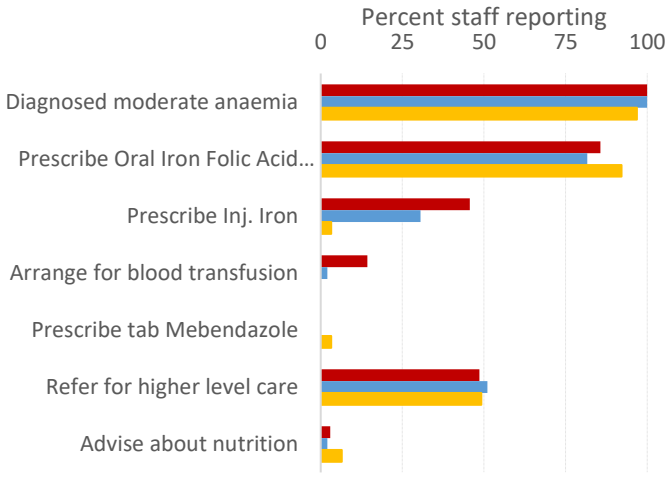
All the staff made a correct diagnosis. Seventy one percent staff from CHCs and 42% from PHCs prescribed anti-hypertensive drugs available at their centres. Forty five percent staff at CHCs, while almost twice this proportion (85%) at PHCs and 94% at SHCs, referred the women for higher care. Blood pressure monitoring was mentioned by half the staff at CHCs and a lower proportion at PHCs and SHCs. Magnisium sulphate prophylaxis, rest and low salt diet were less frequently mentioned.

iii. Labour pains at 30 weeks (Figure-10c)

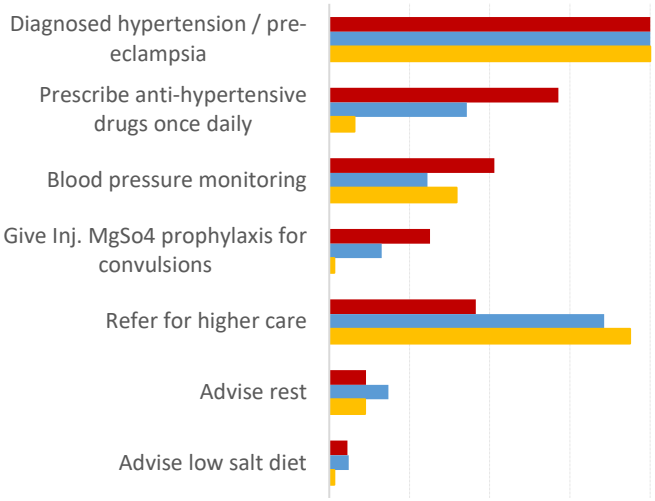
Almost two-thirds staff at CHCs and a half at PHCs would assist the delivery. About two-thirds also mentioned that they would refer the women to a higher centre if the cervix was not fully dilated. Two-fifths of staff at CHCs would give a prophylaxis injection of Dexamethasone if labour could be delayed, but only three doctors (1%) suggested tocolytics to delay labour. Only a few staff from PHCs and SHCs mentioned Dexamethasone and none mentioned tocolytics. On discussion it appeared that they were not aware that tocolytics were a line of management provided at some higher centres.

Figure 10: Management of common high-risk or early complication in pregnancy*

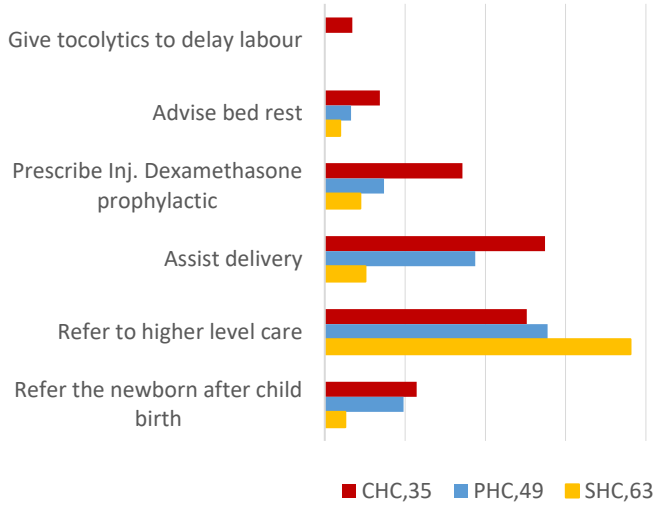
a) Primigravida in 2nd trimester is found to have haemoglobin of 7gm% and no other high-risk or complication. On per abdomen examination foetal movements are palpable.



b) In third trimester pregnant woman on her 4th routine antenatal check-up has blood pressure 160 mm Hg systolic and pulse rate 80/minute. No previous history of high blood pressure. Per abdomen examination finds that foetus has cephalic lie and heart sounds are normal. Biochemical tests show she has haemoglobin 10.5gm%, random blood sugar 80gm% and 3+ protein in urine.



c) Second gravida woman comes to centre in 30wks of gestation with labour pains. On examination pulse rate and blood pressure are normal. On per abdomen examination strong uterine contractions observed. Foetal movements and heart sound are normal. She has haemoglobin 11gm%, Random Blood sugar 100gm% and urine albumin and sugar are negative.



*multiple response possible

3.3.6 Referral for antenatal women

Decisions about which referral centre to choose depended on the indication for the referral and the facilities available. Table-11 describes the type of referral health centre most frequently mentioned by staff at the study centres. ANMs at SHCs mentioned that they referred women to Sub-district and District hospitals only in cases of acute emergency. For other routine investigations and check-ups they referred the women to the nearest health centre (CHC or PHC) for consultation with a doctor. Only two staff admitted that they referred patients to private facilities. Staff reported that public health facilities are instructed to refer the patients to only public facilities.

A large proportion of ANMs at SHCs said they informed the ANM supervisor or staff nurse at the referral centre (CHC or PHC) by telephone. This proportion was lower in PHCs (39%) and lowest in CHCs (14%).

Table 11: Choice of referral centre for antenatal women by respondent place of work (CHC/PHC/SHC)

Referral Centre	Sub-district hospital /CHC, N=35, %	PHC, N=49, %	SHC, N=63, %
PHC	0	0	70
CHC	0	33	46
Sub-district hospital	43	61	29
District hospital	69	31	16
Medical college	14	0	0
Private doctor	0	0	0
Private hospital	0	0	2

There were no records on referrals during ante-natal care. Almost all referrals were from out-patient clinics and only three CHCs and three PHCs had some mention of referrals in the out-patient clinic register. The commonest documented causes of referral

were previous abortion/stillbirth/preterm birth, previous caesarean delivery, moderate and severe anaemia, high blood pressure/pre-eclampsia and bleeding in pregnancy.

Problems faced by the staff, and support required to improve referral, are described in table-12. The staff told that most of the patients were not willing to go to higher centres and several tribal and interior rural areas did not have a transportation facility. Some of the referrals were done for basic investigations because the lab-technician was not available at the CHC or PHC. A few centres that were not delivery points referred women to register at higher centres to make it easier for them to get admission there at the time of delivery. A few doctors mentioned that their referral for antenatal investigations and management for complications were not accepted at the higher centre. The referred women had to re-fill the forms and re-consult the doctor at the referral centre. They often suffered more than the women reaching the referral centre directly. PHCs usually had only one doctor who on many occasions was unavailable to provide emergency care as they were busy elsewhere.

Staff felt that pregnant women should have access to an obstetrician at least once. This could also help staff to manage the women at high-risk and with early complications at their centre as per the advice of the obstetrician. Doctors also suggested a call centre facility to discuss difficult cases and support decision making. Staff nurses from three PHCs demanded support from the doctors to allow provision of better antenatal care and support in decision making. Several staff nurses and ANMs requested training to upgrade their knowledge and skills.

Table 12: Practice, problems and suggestions regarding referral during antenatal care, reported by health staff working at CHC/PHC/SHC

	Sub-district hospital /CHC, N=35	PHC, N=49	SHC, N=63
Components of referral practice, %			
Referral note	69	63	41
Counselling	74	57	65
Advise to call '108' if emergency	74	69	75
Arrange transport	14	6	8
Communicate via phone	14	39	70
Provide stabilising care	14	18	13
Problems faced in referral of antenatal women			
• Patients are not co-operative, they refuse to go to higher centre –CHC & PHC • Transport not available in remote villages. '108' ambulance is sometimes late –PHC in HP • Not a delivery point so referred all pregnant women to the delivery point –PHC in HP • Lab technician not available to provide basic investigations –CHC & PHC in HP • Refer to District hospitals on weekend as doctors may not be available at CHC/Sub-district hospital-PHC in HP • ANM supervisor conducted ANCs and referred by herself –PHC in HP • Referral not accepted at higher centre –PHC in HP • ANC referrals usually from the OPD and there was no record maintenance.			
Support required from system to improve referrals for antenatal women			
• Need access to obstetrician. In case of any high-risk or complication, the patient needs to visit an obstetrician at least once –CHC & PHC • Call centre support to discuss difficult cases • Training required to upgrade knowledge and skills for high-risk and complication cases • Lab technician required at seven PHCs and 2 Sub-district hospitals; radiology services required for USG at CHC or Sub-district hospital. • Transport facility for emergency antenatal care cases –CHC & PHC • Need more staff. PHCs should have two medical officers and at least 3-4 staff nurses and one lab technician –PHCs in HP • Support from senior staff and doctor to allow ANC care and help in decision making for management of difficult cases • Moral support from the system and senior staff should support our decisions • Blood bank and better testing facilities for thyroid and diabetes so that more women can be managed at CHC/Sub-district hospitals			

Staff requested that all the recommended staff should be available at the centre. Some doctors suggested an increase in the recommended number of staff at the PHCs and

upgrading the lab facilities to be able to test for gestational diabetes and thyroid disease at CHCs and PHCs. Almost all doctors would value more moral support from senior officials and requested that the system should respect and stand by their clinical decisions in difficult situations, especially in times of conflict with the community.

3.4 Care during labour

We conducted facility surveys in 14 CHCs and 15 PHCs where deliveries were being conducted out of the 15 and 19 sampled facilities, respectively.

3.4.1 Birthing and EmOC services at CHCs and PHCs from the facility survey

Table-13 describes the birthing services available at the sampled CHCs and PHCs.

Apart from one, SHCs did not have birthing services. PHCs and CHCs where deliveries were being conducted provided all basic birthing services but only 60% used a partograph. The HIV delivery kit was available at most of the CHCs and PHCs. The 24X7 PHCs and CHCs should provide basic emergency obstetric care, but we found that some signal functions were not in some centres- induction of labour, vaccum/forceps extraction, manual removal of the placenta and injectable dexamethasone/betamethasone. Services for neonatal care were also not universally available. Only four of 14 (29%) CHCs had all BEmOC functions. Twenty nine percent of CHCs performed caesarean section as these CHCs had obstetricians but only 14% had a blood bank/storage facility.

Over six months (April 2015-Sept 2015), 3,016 deliveries were conducted in the CHCs and 921 in the PHCs studied. Referral information (in any register) was reported in only 10 of 14 (71%) CHCs and 9 of 15 (60%) PHCs. Among these facilities, on average 18% (Range 3%-36%) and 21% (13%-47%) pregnant women were referred from CHCs and PHCs respectively. The reasons given for obstetric referral are listed in table-14.

Table 13: Services available for management of childbirth by type of health centre (N=29 centres included in facility survey)

	Sub-district hospital / CHC, N=14	PHC, N=15
Basic birthing services, %		
Use of partograph	64	60
Sterilised equipment	100	87
Injection oxytocin 10 IU within 1 min of delivery	100	87
Controlled cord traction & uterine massage	100	87
Dry baby immediately after delivery	100	100
Place the baby on mothers abdomen	79	87
Weigh baby after delivery	100	87
Initiate breast feeding within one hour	100	100
Basic emergency obstetric care, %		
Parenteral Magnesium sulphate/ Diazepam for convulsions	93	73
Parenteral antibiotic	100	93
Parenteral oxytocin for haemorrhage	100	93
Manual removal of placenta/ retained products	86	67
Delivery with vacuum extraction or forceps*	57	0
Induction of labour	71	40
Injection Dexamethasone/ Betamethasone to mother for premature labour	64	80
New born resuscitation with bag and mask	100	93
Injectable antibiotics for newborn sepsis	71	67
Comprehensive emergency obstetric care, %		
Caesarean section	29	0
Blood bank/ Blood storage	14	0
I/v fluids for newborns	71	53
Oxygen for newborns	29	0
Deliveries conducted per centre over 6 months; median (IQR)	111 (64-293)	100 (60-131)
Referred during labour per centre; median (IQR)**	36 (23-43)	20 (19-25)
Proportion of all women in labour referred (referred/(referred+delivered); ; Avg. % (range)	18 (3-36)	21 (13-47)

*facility is available but not practiced regularly; **data available from 10 CHCs, and 9 PHCs only

Referrals were mostly due to medical conditions such as prolonged labour/failure to progress (16% and 31%), moderate/severe anaemia (15% and 13%) and high blood pressure/pre-eclampsia (8% and 9%), followed by high-risk pregnancy with previous

caesarean section (6% and 11%) respectively for CHCs and PHCs. PHCs referred more cases of prolonged labour/failure to progress and previous caesarean section than CHCs. Referral patterns for other causes were similar in CHCs and PHCs. Of the foetal conditions, cases of malpresentation (8% and 8%), foetal distress (7% and 3%), preterm labour (7% and 0%), and meconium stained liquor (5% and 4%) were reported in the notes most often.

Table 14: Reason for referrals during labour by type of centre* (extracted from registers for April 2015 to September 2015)

	Sub-district hospital /CHC, N=437	PHC, N=271		Sub-district hospital /CHC, N=437	PHC, N=271
High-risk	%	%	Medical conditions	%	%
< 20 years	1.4	3.0	High fever	1.6	0.7
First pregnancy at 35 years or later	0.2	0.0	High blood pressure/ pre-eclampsia	7.8	8.9
Gravida 4 or more	1.4	0.0	Eclampsia/ convulsions	2.1	2.2
Previous abortions / preterm birth / stillbirth	1.6	2.2	Moderate to severe anaemia	14.6	12.5
Previous caesarean section	5.9	11.4	Diabetes/ Thyroid disease	0.2	0.4
Short stature/ Cephalo-pelvic disproportion	6.9	5.2	Asthma	1.6	0.0
Foetal conditions	%	%	Prolonged labour (>24 hours) or failure to progress	16.5	31.0
Preterm labour <32 weeks	7.1	0.4	Placenta praevia	1.1	0.4
Meconium stained labour	5.5	4.1	Post-term >40 wks	3.9	2.2
Foetal distress	6.9	3.3	Poly/oligo – hydramnios	3.9	4.4
Malpresentation (Breech lie/ transverse lie)	8.2	7.7	Post-partum conditions	0.0	0.0
Multiple foetus	3.0	3.0	Baby did not cry / baby has any congenital abnormality	1.4	4.8
Cord around neck	1.1	0.7	Post-partum haemorrhage	2.3	4.4
Other conditions	%	%	Other conditions	%	%
Rh –ve blood group	0.5	0.4	Ectopic pregnancy	0.7	0.0
HIV+ve mother	0.0	1.1	Uterine prolapse	0.5	0.0

*data available from 10 CHCs, and 9 PHCs only

3.4.2 Knowledge of screening and referral for high-risk and complications in labour

Only the staff who had assisted delivery of at least 10 pregnant women in the past six months were included in the survey about care during labour. A total of 31 doctors, 53 staff nurses and 63 ANMs provided information across the two states.

Participants enumerated several high-risk conditions and complications that should be screened for during labour and that should be referred on to a higher centre (figure-11a and 11b). These were unprompted responses. The conditions could be broadly classified into the following groups: high-risk in labour, foetal conditions, and medical conditions complicating labour. High-risk conditions in labour were mentioned less often for both screening and referral compared to medical conditions complicating labour.

i. High-risk in labour

Between a quarter and a half of staff mentioned that they screened for elderly primi-gravida, multigravida and history of abortion/stillbirth/preterm birth, and more than half mentioned history of previous caesarean section (figure-11a).

Almost a quarter staff from CHCs and SHCs, and between a quarter and half from PHCs mentioned that they referred the above stated high-risk conditions in pregnancy (figure-11b).

Staff from all three types of centres reported similar high-risk conditions to be screened in labour and to be referred, but there were variations in these proportions—staff from CHCs reported them less often than staff from SHCs and PHCs.

ii. Foetal conditions in labour

Roughly half to three-quarters staff from all types of centre mentioned screening for complications such as meconium stained liquor, foetal distress, multiple foetus, breech lie, transverse lie and obstructed labour. Less than half of staff from CHCs and PHCs

mentioned screening for preterm labour compared to half to three-quarters of staff at SHCs (figure-11a).

Similar proportions, between a quarter and a half, of staff from CHCs and PHCs mentioned that they referred these foetal conditions. A higher proportion of staff from SHCs reported referring women with these foetal conditions during labour (figure-11b).

iii. Medical conditions complicating labour

Similar proportions of staff from CHCs and PHCs mentioned screening for various medical conditions complicating labour. Almost all staff from CHCs and PHCs knew of screening for high blood pressure, over three-quarters mentioned screening for complications such as severe anaemia, eclampsia/convulsions, diabetes/thyroid disease and excessive bleeding during labour, while between half and three-quarters said they screened for retained placenta. A lower proportion of staff from SHCs mentioned screening for these conditions compared to staff from CHCs and PHCs (figure-11a). Staff from SHCs were most likely to mention high blood pressure and diabetes/thyroid disease as conditions to be screened for.

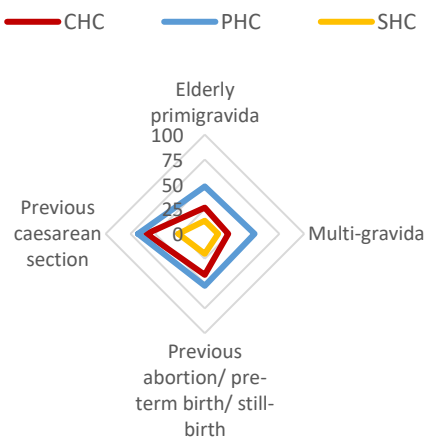
Almost half of staff from CHCs and three-fourths staff at PHCs reported that they would refer women with the above medical complications during labour, except for fever and retained placenta where a lower proportion of staff said they would refer. About three-quarters staff from SHCs mentioned high blood pressure while half or less mentioned other medical conditions to be referred (figure-11b). In general, a higher proportion of staff from PHCs said they would refer these medical complications compared to staff at CHCs and SHCs.

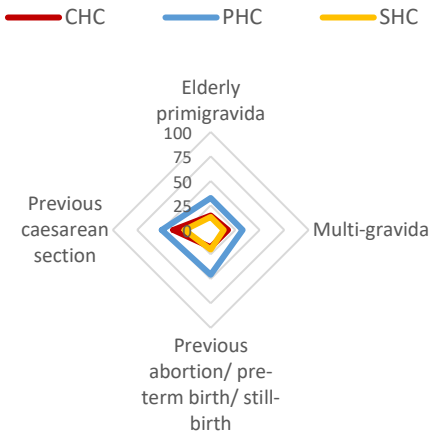
Figure 11: Knowledge about complications during labour to be screened and referred out, among health staff at CHC/PHC/SHC, %

a) Complications to be screened in labour

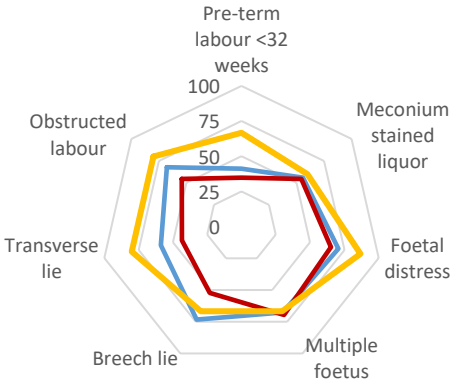
b) Complications to be referred in labour

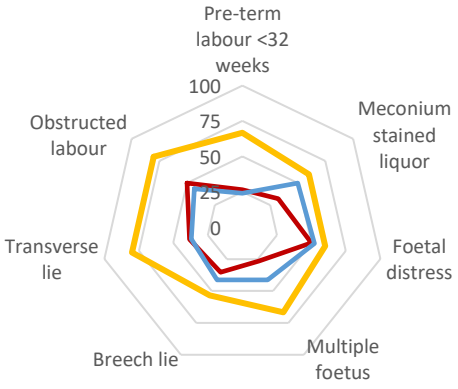
High-risk



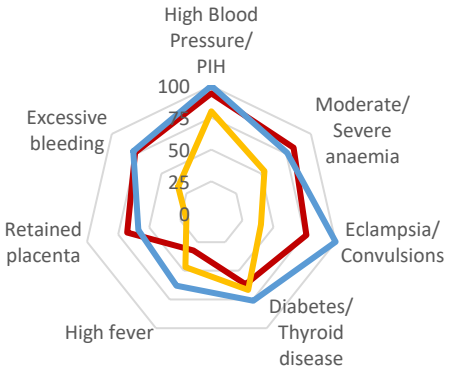


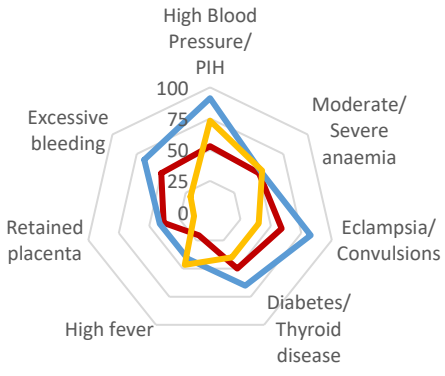
Foetal conditions





Medical complications



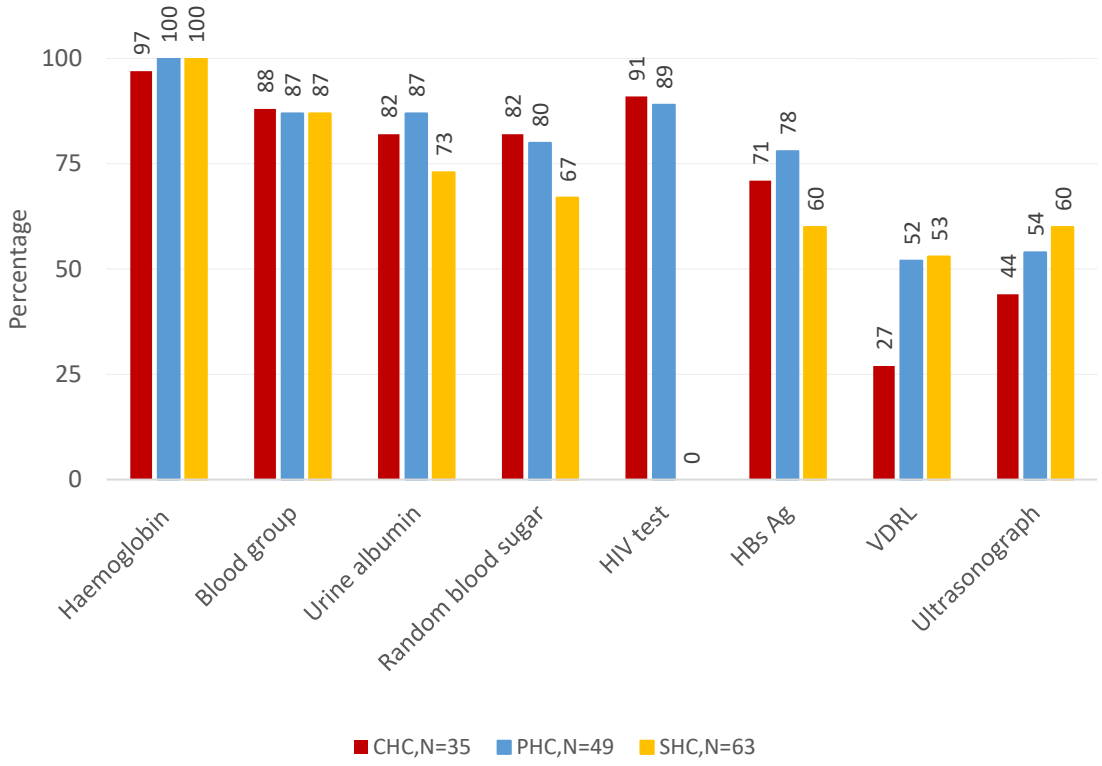


3.4.3 Investigations suggested or reviewed for women in labour

Figure-12 shows the list of investigations that were suggested for women in labour by staff at the respective health facilities. Almost all participants listed blood haemoglobin level and 88% staff listed blood grouping. Over 80% staff from CHCs and PHCs, and 60% to 70% from SHCs, also enumerated urine albumin, random blood sugar, HIV tests and HBs Ag. Tests like VDRL and ultrasonography (USG) of the abdomen were enumerated less often.

Staff from CHCs and PHCs mentioned that if women arrived in advanced labour and did not have any previous report of investigations then they would suggest tests only for haemoglobin levels and blood grouping.

Figure 12: Investigations reviewed or suggested at the time of labour by staff at CHC/PHC/SHC



3.4.4 Birthing practices at CHCs, PHCs and SHCs

Table-15 describes the birthing practices reported by the staff from CHCs, PHCs and SHCs. Roughly four-fifths staff from CHCs and PHCs and only one-fifth from SHCs, reported that they were trained for use of a partograph to monitor progress of labour. Lower proportions of CHCs and PHCs staff stated that they always used partographs. Levels of knowledge about components recorded in partographs were low. Only half the staff felt that a partograph was useful.

Only one-third staff from CHCs and a small proportion from PHCs and SHCs reported that they independently induced labour using oxytocin. However, almost half the respondents only induced labour under supervision by a trained doctor. For management of the third stage of labour, over four-fifths staff from CHCs and PHCs, and only two-fifths from SHCs, mentioned that they gave an injection of oxytocin to the mother within one minute of childbirth. During delivery of the placenta, 88% and 77% of respondents from CHCs, 72% and 52% from PHCs and only 53% and 67% from SHCs said they provided controlled cord traction and uterine massage, respectively. Only two-fifths staff from CHCs, over one-fifth from PHCs, and over three-fifths from SHCs mentioned that they would wait at least 30 minutes before doing manual removal of the placenta or refer the case.

In cases where the placenta is not delivered within 30 minutes, 68% staff from CHCs, 41% from PHCs, and 60% from SHCs would manually remove the placenta while others would refer. After manual removal of the placenta relatively few ANMs from SHCs (44%) would refer the woman for further management at PHC/CHC. Over three-fourths from CHCs and half from PHCs would give oxytocin. Two-fifths from CHCs and one-fifth from

PHCs would give an antibiotic injection to the mother. A very low proportion of ANMs at SHCs would provide oxytocin or antibiotic injections

Table 15: Birthing practices reported by health staff at CHC/PHC/SHC

	Sub-district hospital /CHC, N=35, %	PHC, N=49, %	SHC, N=63, %
Partograph, %			
Trained for using partograph	74	83	20
Used partograph			
Always	59	74	20
Most of the times	6	2	0
Sometimes	9	11	60
Never	27	13	20
Partograph helps in monitoring labour	68	72	27
Induction of labour by Oxytocin, %			
Yes	29	15	7
Only under supervision	50	54	47
Never	21	30	47
Management of third stage of labour, %			
Inj. Oxytocin within 1 minute of child birth	85	83	43
Appropriate delivery of placenta			
Do controlled cord traction	88	72	53
Provide uterine massage	77	52	67
Wait for 30 minutes before intervention	50	24	67
If placenta not delivered in 30 minutes			
Manually remove placenta	68	41	60
Give oxytocin	82	50	7
Give Injection antibiotics	41	22	7
Refer	44	74	80

3.4.5 Practice in management of high-risk and complications in labour

We enquired about the most common high-risk pregnancies and complications (figure-13a) and asked if the participants would- i) assist delivery, ii) assist delivery only if the cervix was dilated to greater than 6 cms, or iii) refer for delivery at a higher care centre. The participants were specifically asked about each condition in turn. Higher proportions of staff from CHCs managed deliveries of women with high-risk pregnancies and foetal conditions in pregnancy, compared to PHCs. Over three-quarters of staff from SHCs referred cases with any of the mentioned high-risk conditions or complications in labour. In the description below we describe the results from CHCs and PHCs.

i. High-risk in labour

Over three-quarters staff from CHCs and almost half from PHCs managed deliveries for elderly primigravida, multigravida and women with previous abortion/stillbirth/preterm birth. If a woman had a previous caesarean section, about half the staff at CHCs would assist the delivery while over half from PHCs would refer.

ii. Foetal conditions in labour

Over half the staff from CHCs stated that they managed delivery in cases of preterm labour, meconium stained liquor, and foetal distress while between a quarter and a half managed cases of multiple foetus, abnormal lie, and obstructed labour. Roughly half of staff from PHCs would assist delivery for preterm labour and meconium stained liquor, but only if the cervix was dilated more than 6cm and there was not enough time to let the woman travel. For other foetal conditions, the majority of PHC staff reported that they would refer.

iii. Medical conditions complicating labour and post-partum complications

Over three-quarters staff from CHCs stated that they managed delivery of a woman if she had complications such as high fever and high blood pressure, and almost half the staff

said they managed delivery for cases of severe anaemia, retained placenta and excessive bleeding post-delivery. Staff from PHCs mentioned that they would refer for most of these conditions, however roughly a quarter said they would assist delivery if the cervix was dilated more than 6cms in a woman with high fever, high blood pressure or severe anaemia. They would also manage excessive bleeding in women delivered at PHCs.

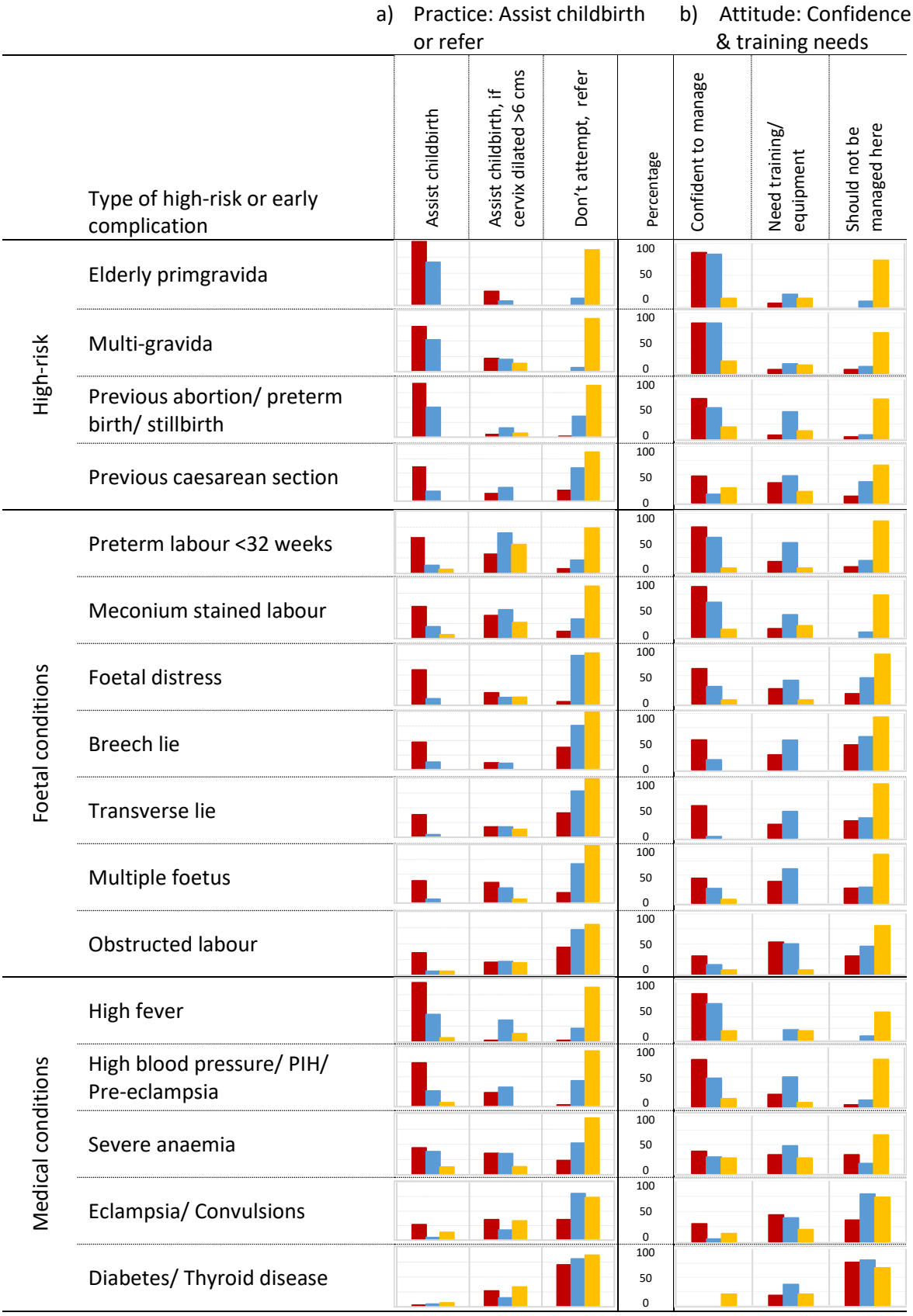
3.4.6 Attitude towards management of high-risk and complications in labour

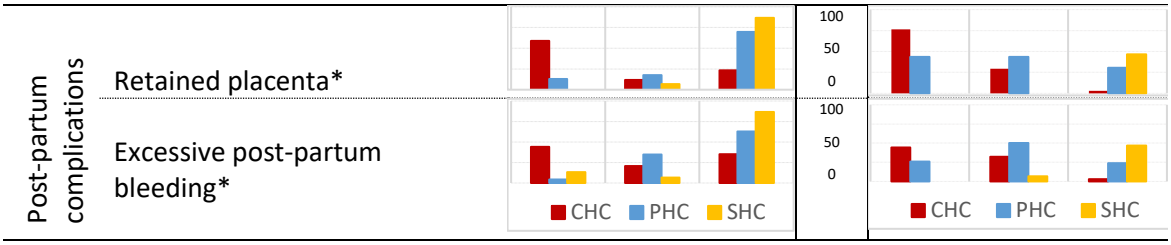
We enquired about the confidence and training needs for the most common high-risk conditions and complications in labour (figure-13b). Roughly three-quarters of staff from SHCs felt that the specified high-risk pregnancies and complications in labour should not be managed at their centre, and only a very small proportion were confident to assist women if delivery was imminent (figure-13b).

i. High-risk in labour

Over three-quarters staff from CHCs and PHCs were confident to manage elderly primigravida and multi-gravida and roughly half were confident in managing previous abortion/stillbirth/preterm birth. If a woman had a previous caesarean section, only half the staff from CHCs and a small proportion from PHCs were confident to manage delivery. Just under half of staff from PHCs asked for training and resources to manage delivery of a woman with previous abortion/stillbirth/preterm birth and previous caesarean section. A quarter staff from PHCs felt that delivery of a woman with previous caesarean section should not be managed at PHC.

Figure 13: Practice and attitude regarding complication in labour. Data presented as proportion (%) of staff at CHC/PHC/SHC responding yes to each question





ii. Foetal conditions in labour

Over three-quarters staff from CHCs stated that they were confident to manage delivery in cases of preterm labour and meconium stained liquor, half were confident in managing foetal distress, multiple foetus and abnormal lie, while only a quarter were confident to manage obstructed labour. Half of staff at CHCs requested training and resources to manage obstructed labour, while a quarter felt that such cases should not be managed at CHC.

Roughly half of staff from PHCs were confident about managing delivery of a woman with preterm labour and meconium stained liquor. For other foetal conditions, PHC staff requested training and equipment. A quarter to half of staff from PHCs felt that conditions such as foetal distress, multiple foetus, abnormal lie and obstructed labour in delivery should not be managed at PHCs.

iii. Medical conditions complicating labour and post-partum complications

Over three-quarters staff from CHCs stated that they were confident to manage delivery for women with high fever and high blood pressure, and to manage cases of retained placenta post-delivery. Roughly a quarter of staff from CHCs requested training and resources to be able to manage cases of severe anaemia, eclampsia, retained placenta and excessive bleeding. They requested provision of blood storage at their centres. Three-

quarters of staff from CHCs felt that diabetes/thyroid disease, and a quarter felt that severe anaemia and eclampsia, should not be managed at CHCs.

Compared to the reported practice, a higher proportion of staff from PHCs stated they were confident to manage delivery if the mother had high fever and high blood pressure and retained placenta post-delivery. They expressed a need for more resources to be able to translate confidence into practice for these conditions. Over half the staff from PHCs requested training and resources to manage other complications, but half to three-quarters felt that delivery of a woman with eclampsia or diabetes/thyroid diseases, retained placenta and excessive bleeding post-delivery should not be managed at PHCs.

The majority of staff stated that they were not well linked with the obstetricians/ doctors at the higher centres and that there was no coordination between care. It was considered safer and more convenient for women with complications to go straight to the higher centre. We observed that two CHCs and one PHC had good linkages and communication with the obstetrician at the next level. The doctors here stated that they could manage more complication cases at their centre following consultation with the obstetrician, and that this reduced unnecessary referral. These doctors were more confident as they also had a ready transportation facility and the referral centre was within one-hour distance from their facility. The doctors in these centres also reported good co-ordination between the doctors and staff nurses at these centres. But they expressed the view that managing cases at night was difficult due to fewer staff and security issues for female staff.

3.4.7 Management of specific case scenarios in labour

The case scenarios and the management as told by the participants is described in figure-14.

i. Pregnancy induced hypertension, on treatment, in active stage-2 of labour (Figure-14a)

More than three-quarters of staff from CHCs and PHCs stated that they would assist childbirth while three-quarters from SHCs would refer to higher level. Roughly two-thirds of staff from CHCs and one-thirds at PHCs would continue antihypertensive treatment. Magnesium sulphate injection was less frequently mentioned.

ii. Primigravida, vertex presentation with obstructed labour (Figure-14b)

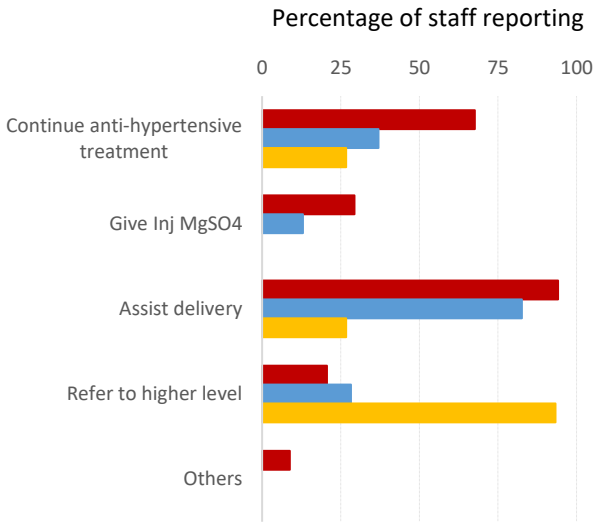
Four doctors from CHCs mentioned that they would perform a caesarean section and about one third of staff from CHCs mentioned use of forceps for managing this case. A small proportion (7%) of staff from PHCs and SHCs also mentioned use of forceps. Others would refer the case to a higher centre. A few (13% to 23%) also mentioned giving an oxytocin drip to support uterine contractions.

iii. Meconium stained liquor in stage 2 of labour, cervix 4cm dilated (Figure-14c)

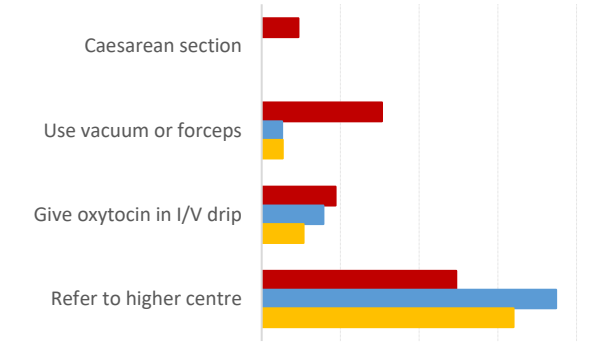
Almost two-thirds staff from CHCs, half from PHCs, and just over a quarter from SHCs would assist the delivery while others would refer to higher centre. Amongst those who would assist delivery, 86% from CHCs and 64% from PHCs would perform mucus suction from the baby's mouth and, if required, they would provide bag and mask resuscitation. A half or more staff would refer the newborn for check-up at higher centre.

Figure 14: Management of common high-risk conditions or early complications in labour*

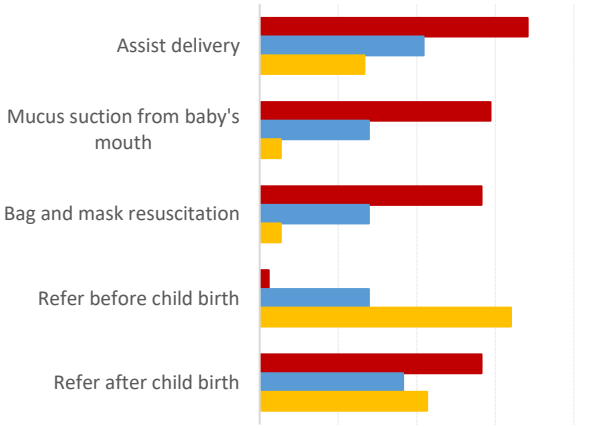
a) A pregnant woman is a diagnosed case of pregnancy induced hypertension and she is on treatment. She visits the centre in active labour stage 2. At the time of the visit her pulse rate was 84/min and BP is 122mmHg/84mmHg. Per abdomen foetal heart sound is 140/min.



b) A primigravida woman is delivering at the centre. The baby has vertex presentation, but during child birth the head is obstructed. Women is exhausted and can't bear pains.



c) During stage 2 of labour you notice the liquor is meconium stained. Mother is bearing normal labour pains. Foetal heart sounds are 150/min. Vaginal examination finds vertex presentation and cervix 4cm dilated.



*Multiple response possible

3.4.8 Referral for women with high-risk conditions or complications in labour

Almost all staff said that they wrote a referral note, counselled the woman in labour or her relatives, and advised the woman or her family to call a '108' ambulance for transportation. Only four participants mentioned that they communicated with staff at the higher centre about the referred case (table-16). Most (85%) staff from CHCs said they provided stabilising care before referral, compared to only a half PHCs and a quarter SHCs staff.

Problems faced by the staff in providing appropriate referral care are summarised in table-16. The staff mentioned that most patients were not willing, and complained about referral to higher centres, especially last-minute referrals. A few doctors mentioned that their referred cases to CHC were often not provided admission and were further referred to a higher facility. While one PHC doctor stated that the next level of care (CHC) did not have CEmOC facility thus they referred the cases straight to Sub-district or District hospitals with CEmOC care. If the public referral hospital was very far, pregnant women mostly went to the private nursing home in case of any complication. The staff also complained about non-availability of HIV kits, equipment and blood storage.

Table 16: Practice, problems and suggestions regarding referral during labour reported by health staff at CHC/PHC/SHC

	Sub-district hospital /CHC, N=35	PHC, N=49	SHC, N=63
Components of referral, %			
Referral note	100	98	93
Counselling	100	98	93
Advise to call '108'	100	96	87
Communicate via phone	3	6	0
Provide stabilising care	85	52	27

Problems faced in referral of pregnant women in labour

- Patients are not supportive, they refuse to go to higher centre – CHC & PHC
- Patients complaint about last minute referrals. Prefer an early referral than later in labour
- Transport not available in remote villages
- '108' is sometimes late – PHC in HP; sometimes '108' ambulance changed three times to reach the District hospital –CHC AP
- Few PHCs not a delivery point so they refer all women – PHC in HP
- Referral not accepted at higher centre- PHC in HP
- Refer to District hospitals as doctors not available at CHC/Sub-district hospital-PHC in HP
- The doctor do not come in time- PHCs in HP and AP
- The Sub-district hospital has obstetrician and staff nurses but deliveries are conducted by TBAs. They have tendency to refer further.
- Even if an obstetrician is available, on her/his duty off days usually other specialists like paediatricians and dentists are on duty. These doctors are not confident to handle the complication obstetric cases, thus refer most of them – Sub-district hospital and CHCs
- NRHM provided the CEmOC infrastructure including exclusive staff nurses for labour room but nurses are posted in regular wards. Only basic delivery services provided to only few pregnant women –CHC in Telangana
- Obstetrician had own private practice. She did not attend OPD or labour room- CHC in AP
- No HIV kits; No blood storage; No facilities to manage Diabetes and Thyroid disease
- No obstetrician or paediatrician –PHC and CHC
- Blame put on junior doctors in Maternal death reviews –CHC

Support required from system to improve referrals for complication in labour

- Need access to obstetrician and paediatrician–CHC & PHC
- Call centre support to discuss difficult cases
- Need more staff. PHCs should have two medical officers and at least 3-4 staff nurses and one lab technician –PHCs in HP
- Need midwifery support / designated nurses for labour room- CHCs
- Need more staff at night—CHCs
- Need more equipment, USG facility and upgraded labour room—PHC

- Transport facility for emergency cases –CHC & PHC
- Better service from '108' ambulance
- Training for Skilled Birth Attendants and Partographs
- Trainings required to upgrade knowledge and skills for complication cases
- Support from senior staff and doctors for supervision and help in decision making
- Maternity waiting homes
- Referral coordinator at referral centre
- Quality improvement at both referring and referral centres
- Moral support from the system and they should support our decisions
- Blood bank and better treatment facilities at CHC/Sub-district hospital level

---

PHCs usually had only one doctor who on many occasions visited community camps, schools and offices within the district, making him/her unavailable to provide obstetric care. There were fewer staff to manage the labour cases at night. A Sub-district hospital in Himachal Pradesh had an obstetrician and staff nurses but deliveries were conducted by TBAs (a traditional birth-attendant who received few weeks training to assist home deliveries). This hospital had a tendency to unnecessarily refer the cases that should have been managed locally. Some staff nurses complained that the doctor did not come to the centre on time for regular duties or when called for emergency. One staff member from Andhra Pradesh mentioned that the obstetrician did not attend pregnant women at CHC but had her own private practice at her husband's nursing home. At this CHC the work was mostly managed by staff nurses and in cases of emergency most women went to this private nursing home. At another CHC, staff nurses recruited for the labour room were used in other ward services and were able to attend only few low-risk delivery cases. The staff stated that during maternal death audits seniors tended to blame juniors: the seniors, rather than providing resources to improve services, unofficially advised staff not to manage any high-risk or complication in delivery.

The staff mentioned the support and resources they need from the higher authorities and the system (table-16). They thought staff should have access to consult an obstetrician to seek help while managing difficult cases. Doctors also suggested a call centre like system to discuss the difficult cases and support decision making. Some doctors suggested an increase in the recommended number of staff at the PHCs. Doctors requested midwifery support or dedicated nurses for labour rooms at the CHCs and Sub-district hospitals. Staff nurses from three PHCs demanded support from the doctors to allow provision of better care and support in decision making. Several doctors, staff nurses and ANMs requested training to upgrade their knowledge and skills. Staff also requested more equipment, upgrading of the labour room, lab facility and availability of blood storage. They suggested measures to be taken to improve the quality of care at both the referring and the referral centres. A referral coordinator should be placed at large referral centres to facilitate access and support to the referred cases. Almost all doctors would value more moral support from the senior officials, and requested the system should respect and stand by their clinical decisions in difficult situations, especially in times of conflict with the community.

3.5 Case studies of pregnant women

3.5.1 Pregnant women in tribal areas arrive late

Pregnant women in tribal regions came very late in labour and left within few hours after delivery against doctor's advice. During a visit to CHC Sahoo, in Himachal Pradesh, we observed the deliveries of two tribal pregnant women. The first woman had walked down the hill in active labour. She was attended by a staff nurse on duty, supported by a TBA. On examination, her cervix was 8 cm dilated and foetal sounds could not be heard. The mother delivered a dead baby.

Another tribal woman who delivered had also arrived fully dilated. The delivery was assisted by the staff nurse and the mother delivered normally. After just 2 hours of the childbirth and shifting into the ward, the relatives insisted on discharge. The husband of this woman, assuming we were some senior doctors, asked us for help.

'*Doctor madam, please ask this nurse to write us medicines and let us go. It is windy and will get dark in few hours, and we need to climb 3 hours.*'

We counselled him for letting the mother and child stay in the hospital for at least 48 hours, especially in the cold weather. The nurse later told us that he left against advice with his wife and child.

3.5.2 Delivery (sub-standard) care by TBA at Sub-district hospital

Deliveries were conducted by TBAs even at a Sub-district hospital in Himachal Pradesh. We attended a delivery of a second gravida pregnant women at CH Nalagarh. The delivery was being assisted by a TBA, however one young staff nurse and a few nurse students were observing. The pregnant woman was fully dilated bearing normal labour pains and pushing when instructed. However, there was some restlessness among staff. We noticed that the TBA gave a premature episiotomy and later one of the student nurses twice pushed the baby down through the abdomen during labour pains. We left the labour room before childbirth to interview the obstetrician in his office. We noticed that as we left, the staff nurse also left the room. In a few minutes the doctor was called from the labour room and we accompanied him. The pregnant woman had delivered. She bore deep vaginal tears (grade 2) and excessive blood loss. The doctor checked the tear and instructed the staff nurse to stich the tear. Within half an hour of delivery, the pregnant woman was referred (to PGI Chandigarh) for excessive blood loss. We observed her being handed over to the '108' technician and being transferred in the ambulance. We cross-

checked the referral notes. The referral notes mentioned excessive bleeding but there was no mention of grade 2 tear or treatment to be given en-route. CH Nalagarh generally had a blood transfusion facility and such patients can be managed at this Sub-district hospital. But they did not have the blood group required for the woman. To us the patient seemed stable and we could not understand the rationale for transfer of this patient unless there was another pathology which we missed when we left the labour room.

3.5.3 Poor compliance and referral advise or support

The referral of antenatal women, and compliance, are complex problems. We observed that antenatal women who required referral were referred from the out-patient clinic and no records of referral were maintained. We witnessed one such referral at CHC Bobbili, Andhra Pradesh. An antenatal woman, gravida 3, was suspected of pulmonary tuberculosis and was referred to the District hospital Vizianagaram which was about 60 kilometres and about two hours away. As she was clinically stable, an ambulance was not arranged for her. At the time of our visit in the CHC, she had returned to consult the obstetrician and requested him to provide treatment at the CHC itself. The obstetrician insisted that she should visit Vizianagram and that the CHC could not help her. The woman reluctantly left from there. The woman had a well worked up antenatal card and it had a referral note too. However, this visit of hers at the CHC or advice for referral was not documented in any register at the CHC. From there we went to the Sub-district hospital Parvathipuram on the same day. While we interviewed the obstetrician at Parvathipuram, we observed the same antenatal woman with her relatives visiting this Sub-district hospital. We were surprised that rather than going 60 kilometres south to the District hospital where she was referred, she came 60 kilometres north to this Sub-district

hospital. The obstetrician read the referral note and asked the patient to go to the District hospital. She refused to provide any support to the antenatal woman.

In the whole situation, it is important to observe that both the CHC and the Sub-district hospital had the capacity to conduct sputum examination, diagnose the case and provide treatment. But both wanted to refer the case. Secondly, none of the obstetricians tried to find the reason why the woman did not want to get treatment from the District hospital. None extended help by way of counselling or facilitating referral by proper communication with the higher centre. We separately enquired with the pregnant women about the reason of non-compliance. The pregnant woman was upset by the behavior of the staff, as well as by the overcrowding at the District hospital. She had a belief that only very sick people go to that hospital, and that women had caesarean sections there, and sometimes babies were born dead. She was not at ease to get treatment and deliver in the District hospital. The system failed to respect her choice of centre and to provide her counselling and emotional support to get treatment in the appropriate place.

3.5.4 No pre-referral care, misdirected first referral, inadequate re-referral.

A pregnant woman with excessive bleeding arrived in a '108' ambulance at Sub-district hospital Parvathipuram, in the tribal region of Andhra Pradesh. The woman was in labour and was first transported to a nearby PHC by the ambulance. The staff nurse at PHC diagnosed that the baby had died in the womb, and due to excessive bleeding mother needed a blood transfusion. We found out, from the '108' emergency technician, that the nurse referred the pregnant woman to the Area hospital without providing any stabilising care. The technician, in consultation with the '108' call centre doctor, started i/v fluids and closely monitored her vital signs. The journey from home to PHC and to the Area

hospital took about 75 minutes. When the pregnant woman reached the referral hospital she was appropriately handed over to the obstetrician on duty with all case details. Soon after that, the ambulance left. The obstetrician and nurses actively evaluated the case and prepared for blood and caesarean section. But the blood group of the pregnant woman was not available in the hospital. The hospital had a blood storage facility but had exhausted blood supplies of that specific blood group.

The obstetrician in anguish complained about the nurse from PHC and the '108' technician for not enquiring about availability of blood before transferring the patient to this hospital. The obstetrician noticed that there was extensive blood loss and the patient required blood. Within 10 minutes, she prepared to refer the case to another centre but the '108' ambulance that brought the case had already left. The staff nurse thus called for another '108' ambulance. The patient was put on the ambulance within 20 minutes of her arrival for another journey of about 90 minutes, towards a District hospital where blood bank was available.

We noticed that even this obstetrician did not enquire about availability of blood at next level. We could not take personal details of the patient thus could not follow the outcome. The obstetrician told that she hardly followed her cases after referral, nor did she receive any feedback.

4 DISCUSSION

This study is one of only a few studies from India to assess the providers' knowledge, attitudes and practices on screening, management and referral for high-risk and complication both during the antenatal and intra-natal period.

4.1 Antenatal care

Most studies on quality of antenatal care from low and middle-income countries (LMIC) have assessed practice through case records and observations. This study comprehensively assessed providers' knowledge and attitudes, in addition to practice. We discuss our findings with respect to guidelines for India and findings from other studies.

4.1.1 Sub-optimal screening in antenatal women

We observed that staff were more likely to report that they screened for high-risk conditions and early complications by taking a history and conducting laboratory tests than conducting routine screening such as abdominal examination. A study from Pakistan reported the reverse, where history taking was observed for less than 30% pregnant women while examination was for 50% or more.(116)

The health centres in our study did not have the capacity to conduct all recommended lab tests. The staff mostly referred pregnant women for tests which were unavailable at their centres. All staff said that they advised tests for haemoglobin and HIV while less than 60% advised VDRL and USG. The results were similar to findings from Belgaum and Nagpur in India where they observed antenatal women being tested for haemoglobin (86% and 99%), HIV (99% and 98%) and syphilis (19% and 47%).(117) Studies from other LMIC reported that between 30% and 70% of women received these lab investigations at peripheral health centres in the antenatal period.(116, 118-121)

Overall, only a quarter of staff in our study mentioned screening for all common high-risk conditions and early complications. In a study from Malaysia, 35% antenatal women were assessed according to the complete risk assessment criteria.(122) Other studies from LMIC have also found that a quarter to half of antenatal women received good or

moderate quality of antenatal care.(67, 116, 118, 121, 123-125) Low adherence to minimum levels of recommended ANC content was also observed in developed settings.(126-128) There were variations with different provinces and socio-economic status.(129) Studies also found that screening for high-risk and early complications had greater adherence than health education or other prescriptions.(116, 124-126).

We observed that routine antenatal care even at PHCs and CHCs was mostly provided by ANMs. Knowledge of screening for high-risk was better among ANMs compared to doctors or staff nurses. A study from northern Karnataka, India also found that ANMs were more confident than staff nurses to manage routine antenatal care and to identify complications.(130) In contrast, ANMs' ability to manage complications in pregnancy was poor and ANMs did not provide any first-aid before referral.

4.1.2 Inadequate management and referral for early complications in pregnancy

As expected, doctors and staff nurses at CHCs were confident to manage complications in pregnancy. But it was disappointing to observe that 50% or more staff from CHC would refer the antenatal women with severe anaemia, eclampsia, bleeding in pregnancy, diabetes/thyroid disease or foetal distress. CHCs in India are meant to operate at a CEmOC or at least a BEmOC level, that can manage common obstetric complications,(58) but this was not the case in our study. CHCs did not have blood transfusion facilities. The staff were either under-confident, did not have enough resources, or felt that the complications should be managed only by obstetricians. A few, including obstetricians at CHC, stated that the district administration discouraged them to manage complications at their centres.

`Doctors and staff nurses at PHCs were only slightly better than ANMs for managing complications. Most staff nurses and a few doctors were either not confident, or they felt that complications should not be managed at PHCs, thus they referred such cases. ANMs were not competent to manage early complications but only one-third mentioned referrals for such cases. They routinely advised women to consult a doctor at PHC at least once during pregnancy for assessment and appropriate management.

We assessed staff for common case scenarios. If a pregnant woman presented with moderate anaemia, staff advised two IFA tablets per day, and a few from CHCs and PHCs also mentioned injectable iron for treatment. As per guidelines, such case should be easily managed at CHCs and PHCs (58) but we observed that a considerable proportion of staff mentioned that they would refer the case to higher centres.

We observed that management of pre-eclampsia was better in CHCs than PHCs, but still it was lower than that expected at BEmOC centres. Only 70% of those from CHCs and 40% from PHCs would give anti-hypertensive drugs, and 31% and 16% would provide an injection of $MgSO_4$. Our results are very similar to a study from six African countries where provider knowledge about diagnosis of pre-eclampsia/ eclampsia exceeded 80%; however, knowledge of first actions to be taken varied from 33% to 77%, and action to be taken in the event of a convulsion did not exceed 51% in any country.(131) Staff nurses in our study consulted the doctor in-charge before administering any drug for complications. In the absence of a doctor, they referred the women without any treatment. ANMs in our study did not provide any treatment for pre-eclampsia or eclampsia. A qualitative study from India also found that ANMs at SHCs and staff nurses at PHCs had good understanding for identifying pre-eclampsia and eclampsia, apart from testing for proteinuria. Nurses

were not aware of correct dosages and routes of administration of drug treatments, thus were not confident to manage eclampsia cases.(130)

If a woman arrived in labour at 30 weeks, 43% staff from CHCs, 18% staff from PHCs and 11% ANMs from SHCs mentioned that they would prescribe injection Dexamethsone/ Betamethasone before childbirth. But ANMs and staff nurses did not know the dosage. A study from LMICs also reported that corticosteroid was administered in very low proportions before the birth of preterm and small babies (2% in Kenya, 3% in Zambia, 4% in Pakistan, 5% and 11% in India, 12% in Guatemala and highest 44% in Argentina). The study also observed that use of corticosteroids was absolutely nil in peripheral health centres.(132) Staff nurses and doctors in our study preferred to deliver a preterm baby but to refer the new born to newborn intensive care unit after birth. They did not realise that they should try to delay labour and refer such case before childbirth.

4.2 Care during labour

Health centres in my study had inadequate birthing and emergency obstetric services which affected the quality of care provided and the quality of referrals.

4.2.1 Sub-optimal screening during labour

In our study, 25% to 50% staff mentioned screening for common high-risk in pregnancy based on history. Between 50% and 75% staff screened for foetal and medical conditions complicating pregnancy via assessment. Overall, only one-quarter of staff in our study mentioned screening for all common high-risk conditions and early complications during labour. A study from Malawi observed a performance index of only 2 out of 5 for the initial risk assessment and risk monitoring during childbirth. The study found that risks for prolonged labour and foetal distress were more often screened than high blood pressure, bleeding, infections and pre-eclampsia.(133) A study from three other countries in Africa

found that history taking, examination and monitoring of the mother during childbirth was inadequate, and laboratory investigations and counselling practices were poor.(134) A qualitative study from Madhya Pradesh, India observed limited screening and monitoring during labour and immediately after delivery, and poor coordination between providers for assessment and sharing of information.(135) Similar low-risk assessment and monitoring was observed from other parts in India, but after training for using checklists and close supervision, good practice increased markedly.(136-138)

4.2.2 Inadequate management and referral for high-risk or complications in labour

Management of complications and patterns of referral were different for the three levels of care. Half of the staff at CHCs would assist childbirth of pregnant women with previous caesarean section, and physiological foetal conditions (preterm labour, meconium stained liquor and foetal distress), but less than half would manage anatomical foetal conditions, severe anaemia, and eclampsia. We observed that although the provision of BEmOC services were only slightly better at CHCs compared to PHCs, the management of complications was noticeably better. This was due to four CHCs were an obstetrician was available. PHC staff would refer previous caesarean section and all complications, but if the cervix was dilated and it was too late to refer then half of staff could assist childbirth for preterm labour and meconium stained liquor. Endocrine disorders in pregnant women were least likely to be managed and a large proportion of staff felt that endocrine conditions should not be managed at CHCs or PHCs. Most ANMs in our study referred high-risk conditions or complication cases without attempting childbirth or providing first-aid.

We assessed the quality of management in labour using common case scenarios. We observed that less than 25% staff would administer MgS04 for management of a case of pre-eclampsia during childbirth. This was consistent with other findings from India (139) and other developing countries.(131) Three-quarters of staff at CHCs and half at PHCs would deliver a mother with meconium stained liquor and a lower proportion mentioned that they would provide mucus suction and resuscitation if required. It is important to note that at a few facilities, obstetric care was provided by TBA*s*, who were not even SBA trained. In these instances the quality of obstetric care is comprised.(140)

Overall, studies from the developing world –including ours- shown low competence in risk assessment, risk monitoring and risk prevention.(57, 131, 133, 139, 141-145) The staff at lower level centres have a tendency to refer any complication without providing stabilising care. This may endanger the patient's life en-route.

4.3 Inconsistent birthing and obstetric emergency functions

CHCs and PHCs in our study had the capacity to provide most of the basic birthing functions but only a few basic emergency obstetric signal functions. Even if caesarean facility was available at CHCs, other BEmOC functions were not. A study from six countries (including India) in 2010 found that only 2.3% facilities expected to provide BEmOC could provide all the seven signal functions required, and only 23% facilities expected to provide CEmOC could provide all the nine required signal functions.(57) None of the designated EmOC centres provided all signal functions, and the providers lacked the EmOC skills required.(140) A study in Uttar Pradesh also observed that there was inconsistency in the availability of resources, including availability of obstetricians and doctors.(71)

In our study, an encouraging four-fifths of staff at CHCs and PHCs mentioned administering Injection Oxytocin within one minute of childbirth, and about two-thirds

used a partograph. In India, use of the WHO Safe Childbirth Checklist was recently piloted in few states, and studies have found some improvement in basic signal functions. Administration of oxytocin injection increased from 8% to 70% in Uttar Pradesh (138), 24% to 88% in Rajasthan (137) and 57% to 90% in southern Rajasthan.(136) After training to use the WHO safe child birth checklist, use of a partograph increased from 13% to 52% in Rajasthan (137) and from 3% to 48% in Uttar Pradesh (138), although in another study the increase was not so pronounced (11% to 18%).(136) A record review from African countries reported low use of partographs in Ethiopia and Madagascar (13%–27%), and high use in Kenya and Rawanda (83%–88%).(57) However, the partographs were not correctly completed in the majority of cases in any country, and in many cases they were completed only after delivery.(57, 146) Appropriate delivery of the placenta and use of MsS04 for pre-eclampsia and eclampsia were also less practiced.(140)

Among BEmOC functions, use of vaccum/forceps, induction of labour, and injection of Dexamethasone/Betamethasone for premature labour was low despite the availability of resources. Staff from the centres that did not have a caesarean facility refrained from practicing induction of labour. In developing countries only 3–18% health facilities from four African countries and 40% from two Asian countries (including India) performed assisted vaginal delivery.(57) Unlike our study, other studies from India suggest a high proportion (70%-86%) of induction or augmentation of labour.(142, 147) A study from Rajasthan showed that by promoting evidence-based good practice for care during labour, induction of labour decreased from 93% to 45%.(136).

CHCs in our study had only slightly better availability of BEmOC functions than PHCs. In such a scenario, staff at PHCs preferred to refer women to CEmOC at Sub-district hospitals, District hospitals and medical colleges.

4.4 Factors related to referral for women in pregnancy and childbirth

In our study centres, 18% (range 3% to 36%) women in labour from CHCs and 21% (range 13% to 47%) women from PHCs were referred. These were higher than the proportions found in a systematic review from India, where 2 to 7% women from doctor-run BEmOC centres were referred, but similar to the 14%-36% referrals from nurse-run basic birthing centres reported in the same review.(114) Most of the studies in this review were interventions under supervision, thus the referrals may have been less required. The causes for referral in our study and this systematic review were similar. Referrals were mostly due to medical conditions such as prolonged labour/failure to progress, moderate/severe anaemia, high blood pressure/pre-eclampsia and previous caesarean section. Referral for foetal conditions was mentioned less often and was mostly for malpresentation, foetal distress, preterm labour, and meconium stained liquor.(114) PHCs were observed to refer a very high proportion of women with prolonged labour/failure to progress labour, which may be an indication of either hastiness in decision making or a tendency to transfer the burden to a higher level.

Under-confident staff, poor skills, lack of resources, lack of support from seniors and the system, and lack of communication between levels of care contributed to inadequate and unjustified referrals.(114, 121) It has been reported that feedback from clients, professional referral support, and frequent mentoring would improve their confidence and scope for service delivery.(121) Qualitative findings from our study suggested that poor referral communication between centres, poor logistic management of blood storage, and over-reliance on the availability of an obstetrician led to misdirected referrals

and added to delays in access to care. This, in addition to poor access and long distances to reach EmOC facilities, worsened en-route health status.

In case of any high-risk condition and early complication in pregnancy, staff suggested that the women should have at least one check-up by an obstetrician. Although staff had the ability to manage antenatal care for such cases, they preferred to refer them in advance if the centre did not have facilities to manage childbirth. Referral to higher level for lab investigations and USG were also common. We observed that ANC referrals were mostly from out-patient clinics and there was no documentation for out-referrals.

Childbirth in our study was mostly assisted by staff nurses, but they were highly under-confident and relied on a doctor's judgment and decisions in cases with a complication. A study from two tertiary hospitals in Maharashtra, India, examined 877 near-miss pregnant women and found that two-thirds were referred and faced problems due to non-availability of treatment at lower level centres.(148) A study from Karnataka, India found that only 20% Sub-district divisions had access to a functional EmOC.(52) This was partly because of absence of doctors and infrastructure, but most important was lack of midwifery skills and confidence among nursing staff and doctors at the lower centres. Midwifery may also humanise care.(149) The midwifery practice of staff nurses in India is limited and their potential is under-utilised. A nurse's right to practice is not well defined and the extent of their work is restricted due to unrecognised official status to practice. Even in their training, clinical midwifery is marginalised and exposure is for few practices only.(150) We observed that referral is directly linked to provision of quality obstetric care that is led by motivated health staff who are trusted, respected and supported by the health systems. The needs of the providers should also be addressed.

Between 60% and 75% staff in our study provided counselling for referral and advised patients to call '108' in case of emergency. Staff mentioned that many referred cases did not comply with their advice. This could be due to women's perception about the severity of her condition, the quality of services at higher centres, costs and distance to the referral centre, and poor counselling.(151, 152) Non-compliant referred cases are likely to go to a tertiary level of care, or to access private care. This may add to out-of-pocket expenditure. The NFHS-4 survey (2015-16) found that 62% of women delivered in private facilities in Andhra Pradesh and only 21% in Himachal Pradesh.(44) Unlike Himachal Pradesh, the doctors in Andhra Pradesh were permitted to do private practice, which could have played a role in referral to private facilities, although not mentioned in the interviews. Qualitative studies from Jharkhand and Uttar Pradesh, India, observed that the pregnant women wanted nurses to have higher skills so that they could provide a less painful clean delivery, appropriate care in case of complications, emotional support, and respectful treatment.(71, 153)

We observed that the decision of where to refer to was based on knowledge of the availability of a doctor, a blood bank/storage, and a functional lab and USG facility. However, there was no mechanism to provide real-time awareness about the availability of the services when such decisions were made. Only a few staff provided any stabilising care before referral or communicated about the referred case to the higher level centre. Poor first-aid or pre-referral stabilising care was observed across centres and cadres in our study and other studies.(126, 131) The reproductive health programme in India suggests that a community health worker or ANM should accompany women with complications when referred to a higher level centre.(14)

4.5 Strengths, Limitations, Recommendations

My study was able to assess the quality of obstetric and referral care across a range of health care centres, and types of staff, in the study districts. We were thus able to compare and contrast some of the findings according to both health care level and staff experience and training. The survey data enabled a thorough analysis of knowledge, attitudes and practices of health care providers about obstetric practice and referral to higher levels of care for women with obstetric high-risk and complications. The survey data were supplemented by information from facility surveys, and formal and informal interviews, to enable a comprehensive analysis of referral in obstetric care in the study centres.

Our study had a few limitations. The practices of health staff were assessed by interviewing them rather than direct observations. The staff may have over-stated or under-stated actual practice, but we found that our findings were close to findings from other observation studies from India. We also noticed that within our study, findings related to knowledge, practice and attitude were consistent with each other, and with the qualitative findings. We did not have a planned qualitative component in this study, but interviews spontaneously extended into discussion of other systemic issues contributing to quality of obstetric care. We used this as an opportunity and presented our observations and case studies.

With regards recommendations, the results of this study suggest that to improve obstetric outcomes, emphasis must be placed on health systems strengthening (including human and material resources, protocols and services), with added focus on decisions for referral and quality of pre-referral stabilising care. This will reduce many unjustified referrals from CHCs and will provide accessible referral care to those referred from PHCs

and SHCs. Skills of staff at lower levels of care should be improved, with provision of continual mentoring to reduce unnecessary referrals. Health staff should provide privacy and respectful care to the women and provide appropriate counselling for referral.(140) Policy makers should strengthen midwifery skills of providers and devise mechanisms to promote midwifery-led care.(150, 154)

Other recommendations regarding referrals are that mechanisms should be devised to ensure the availability of transport, adherence to referral advice, and to improve communications across levels of care.(15) The most peripheral centres should refer the complication cases directly to the nearby CEmOC, bypassing inefficient intermediate levels of care.(140) The health systems should respect the needs and concerns of providers, provide feedback and moral support. It is recommended that administrations should strengthen documentation for case sheets, registers and reports, especially at lower centres.(155, 156) Finally, the RCH programme should include process and outcome indicators for assessing quality of obstetric care, and appropriate referral and transfers.(156)

4.6 Conclusion

Staff in peripheral public health centres had sub-optimal knowledge of, and practice for, screening of common high-risk conditions and complications in pregnancy and childbirth. There were large gaps in knowledge of first-aid for obstetric complications.

Knowledge of antenatal screening among ANMs at SHCs was better than the staff at CHCs and PHCs, but management by ANMs was poorer. CHCs were supposed to provide BEmOC but only a quarter to a half of staff managed common complications. A large proportion of staff from CHCs and PHCs referred pregnant women with high-risk conditions or early complication in pregnancy after giving some treatment. ANMs referred

most early complications without providing any treatment. Some referrals were for routine lab investigations and USG.

Knowledge of screening for high-risk and complications during childbirth were better among staff from PHC followed by CHCs and SHCs. Staff at CHCs managed most high-risk conditions and a few medical complications, but would refer most foetal conditions, severe anaemia, eclampsia and endocrine conditions. Staff at PHCs managed low-risk deliveries and only a few high-risk cases. ANMs referred all women in labour.

Staff were generally under-confident, or did not have resources, or felt that some complications should only be managed at higher levels by obstetricians. Staff desired skill building, mentoring, and moral support and motivation from senior officers.

We conclude that the health systems should improve the provision of obstetric care in India by standardising services at each level of health care, and increase the focus on first-aid for complications, appropriate decision-making for referral, and improving referral communication. Indicators to monitor referrals should be incorporated in plans for monitoring quality of obstetric care.

SECTION C

Transport for pregnant women in India

Systematic review-6
The ‘108’ ambulance service-7
Analysis of ‘108’ data from six states-8
Telephone survey of pregnant users of ‘108’-9

CHAPTER 6: TRANSPORT INTERVENTIONS FOR PREGNANT WOMEN IN LABOUR, WITH OBSTETRIC HIGH-RISK, COMPLICATIONS, OR EMERGENCIES IN INDIA – A SYSTEMATIC REVIEW

1 INTRODUCTION

The research presented in Section-B highlighted the importance of referral systems in EmOC, and the availability of timely and efficient transport is an essential part of this system. Transport problems contribute to Phase II delays in accessing appropriate obstetric care.

In India, studies reveal that about one-third to a half of reported maternal deaths occurred at home or during transit from home to a hospital, or between facilities.(12, 37, 55, 157, 158) The transfer of pregnant women to appropriate health facilities, with en-route stabilising care, plays a pivotal role in preventing maternal deaths.(10, 15, 159, 160) At least 20 referral transport interventions have been tested across India.(161)

Pregnant women in India use publicly funded free '108'/'102' call centre based ambulance services (42, 83, 162), paid subsidised or commercial services, or personal transport. The '108' service is the most dominant model across 16 states that provides cashless services for any emergency. The '102' service is free for women in pregnancy and up to 6 weeks after delivery, and neonates up to 2 weeks, in 10 states.(163) *Janani Express Yojana* (JEY, public private non-ambulance transport service), operating through call-centres within districts, transfers exclusively pregnant women and newborns in Madhya Pradesh and Odisha.(164-166) Assam and Tamil Nadu have a dedicated fleet of

ambulances for all inter-facility transfers. In larger cities some other ambulance services (free or paid) are also available.(167)

There is a paucity of evidence from India on the effectiveness of interventions for transport for pregnant women in India. This systematic review from India will help us to understand the type of interventions available, their patterns of use, and their effectiveness.

1.1 Aim

The primary aim of this review was to summarise evidence on the effectiveness of interventions to provide transport for emergency obstetric care in India. A secondary aim was to describe the socio-economic and medical characteristics of the pregnant women who are transported by these interventions.

2 METHODS

The research obtained ethics approval from ethics committees of both LSHTM and IIPH-Hyderabad. (LSHTM Ethics Ref: 9613; IIPHH Ethics Ref: IIPHH/TRC/IEC/009/2014)

2.1 Search Strategy

The literature search was conducted using six mainstream databases (Medline, Embase, Popline, IMSEAR, Cochrane Central Register of Controlled Trials (CENTRAL) and CINAHL) and four other databases (WHO, UNICEF, UNFPA and Indian RCH repository). Grey literature sources, such as programme reports, were also used. The review was restricted to studies from India, published in English between 1996 and 2015.

The electronic search strategy was based on terms related to transport, transfer, or emergency ‘and’ pregnancy/or in obstetric emergencies/or complications/or high-risk ‘and’ India (Annex-VI). Appropriate MeSH and/or keywords using respective thesauri were

used. A list of innovations in providing transport for pregnant women was obtained from the Directory of innovations in RCH, published by the Government of India.(42) Efforts were made to retrieve relevant programme reports and unpublished data or studies related to these listed innovations.

2.1.1 Inclusion criteria

i. All studies (hospital or community based) and reports with transport interventions in obstetric care, with any kind of epidemiological study design, were included. Reports and unpublished research were also included.

ii. Type of participants in the studies or reports: Studies of pregnant, post-abortion and post-partum women using any form of transport to reach a public health facility were included.

iii. Type of Interventions: Any study with interventions aimed to overcome phase II delay in reaching an appropriate facility, were included. These interventions could include birth preparedness, transport, financial or cash incentives for transport, triage and pre-hospital treatment.

iv. Place of intervention: India

2.1.2 Exclusion criteria

i. Studies or reports on transportation interventions for non-maternal conditions.

ii. Editorials, commentaries and letters.

2.2 Screening

Screening was done by two independent researchers (myself and PB) using the inclusion and exclusion criteria. Screening was first done based on titles and abstracts and then subsequently by reading full texts. Disagreement between reviewers was resolved by discussion and establishing consensus.

2.3 Data collection

Measurement indicators studied were: the proportion of pregnant women transported; reason for transportation; place of pick-up and drop-off; pre-hospital treatment; availability and arrangement for transport; type of transport and communication; distance and times of journey. Data extraction forms were developed and piloted before use. Information was extracted on the type of intervention, and the prevalence of outcomes and costs were considered. Key qualitative findings were also recorded and described.

The quality of papers was assessed using STROBE guidelines (88) for observational studies and CONSORT guidelines (89) for intervention studies. A score of 1 was assigned to each item in the checklist and a total score was calculated for each paper (maximum score- STROBE=22; CONSORT=25). A score below 11 out of 22 for observational studies, and below 13 out of 25 for intervention studies, indicated poor quality. The potential risk of bias in methods (selection, performance and detection), analysis and reporting were assessed for each study. Reviewers also discussed the limitations in combining the results from different studies in the review.

2.4 Synthesis of results

Each selected study was assessed with respect to the type of study and measurement indicators. Findings were summarised by type of intervention.

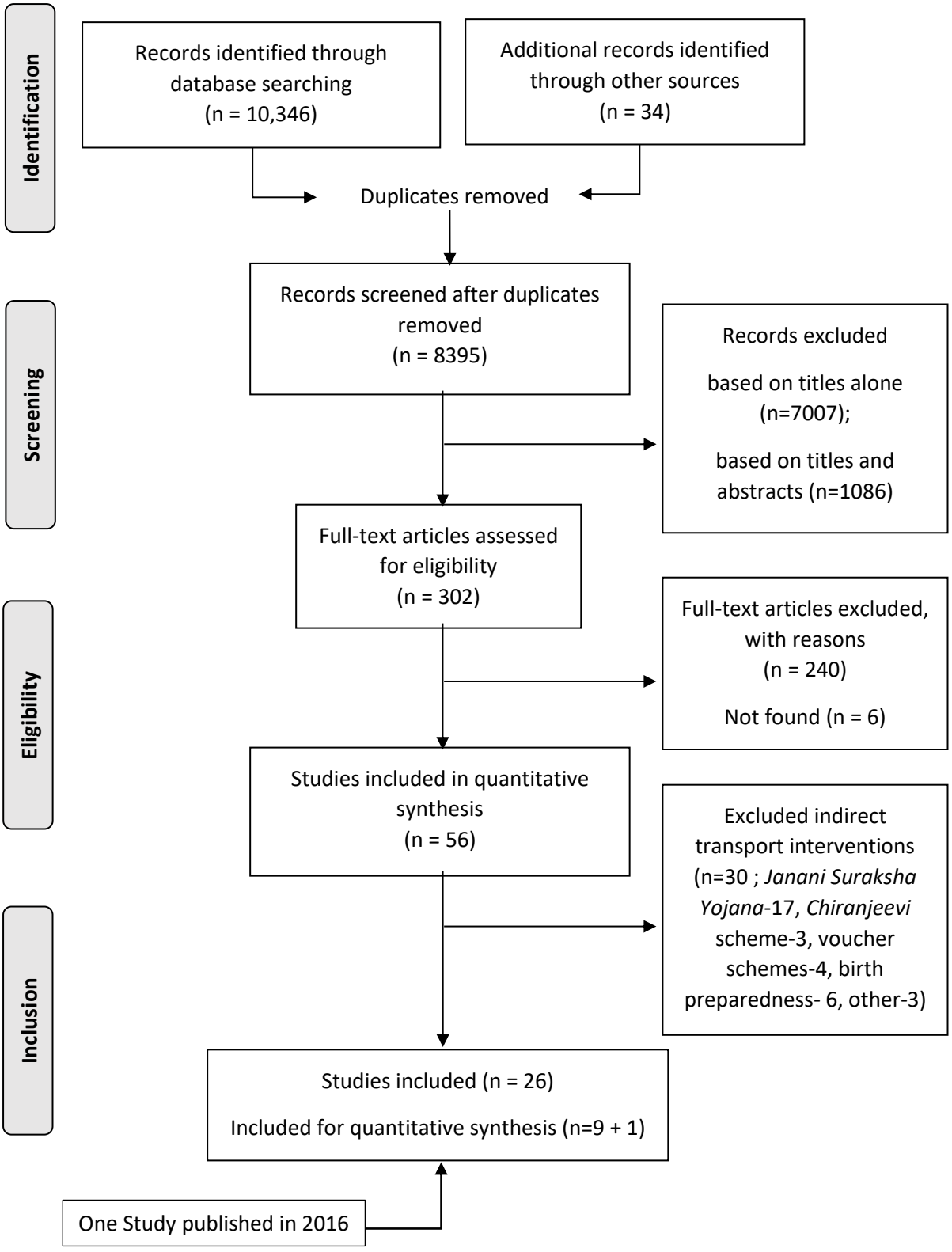
3 RESULTS

3.1 Search results

We identified 56 papers/reports that met the inclusion criteria. Seventeen papers/reports studied the *Janani Suraksha Yojana* which provides a fixed cash incentive to women delivering in health institutions to support costs of antenatal and delivery care including

transport. The incentive is not directly linked with transport support, so these papers were excluded.

Figure 15: Flow diagram for selection of studies for systematic review on transport interventions for pregnant women



A further 13 papers/reports included indirect interventions for transportation such as cash vouchers for pregnancy care, birth preparedness and home based maternal care. These indirectly promoted planning for a transport, but none actively linked the beneficiary with any transport facility. We excluded these studies from our review.

The remaining 26 studies/reports reported on direct transport interventions such as '108', '102', JEY, and a community-based trial for improving emergency obstetric care (EmOC). Of the 26, there were two case studies each on '108' services (168, 169) and JEY (170, 171); two reports based on '108' call-centre summary data (83, 172); and a concept paper on emergency ambulance services for India.(165) Another seven studies on '108' services did not report separate data on pregnant women users.(162, 173-178) Two studies on JEY conducted desk reviews and some qualitative interviews, the methods of which were not provided.(164, 179) We used these 16 studies/reports to understand the interventions but excluded them from quantitative analysis.(162, 168, 169, 173-178)

A report on transport intervention models consisted of sub-studies on '108', '102' and JEY from three states, Andhra Pradesh, Haryana and Orissa, respectively.(164) The sub-studies from Andhra Pradesh and Haryana were also published as papers which presented more information thorough methods and results, thus we included the papers (180-182) rather than the report. But for Odisha we extracted results from the report. There were two papers from a cluster randomised trial to improve emergency obstetric care (EmOC)—one described the intervention, and other presented the results. We included both papers to review methods and extract data on results.(69, 95) During analysis we found a new research paper on '108' published in 2016. We included this paper also for analysis.(183)

Table 17: Characteristics and quality of studies included in systematic review on transport for pregnant women in India

SNo	Author	Type of study	Time of study	State	Rural/ Urban	Participants (N0.s)	Quality score*	Potential bias
'108' ambulance service								
1	Raj, 2009 (184)	Retrospective analysis of data	2007-2008	Andhra Pradesh	Rural and Urban	Pregnant women users (121,454)	11/22	Reporting/ Recording bias: Possibility of incomplete, incorrect, duplicate and missing data Detection bias: Clinical assessment made by the call centre technician or ambulance crew. The quality of recording and diagnostic criteria may have varied from person to person.
2	Jena, 2010 (185)	Retrospective analysis of data	2009	Andhra Pradesh	Rural and Urban	Pregnant women users (105,951)	12/22	Selection bias: 105,951 women were selected out of 323,495 but selection criteria is not mentioned. Reporting/ Recording bias: Possibility of incomplete, incorrect, duplicate and missing data Detection bias: Clinical assessment made by the call centre technician or ambulance crew. The quality of recording and diagnostic criteria may have varied from person to person.
3	Surendra, 2011 (182)	Desk review and Cross sectional study (hospital based, public)	2010-11	Andhra Pradesh	Rural and Urban	Hospital- Admitted pregnant women in emergency ward (102; users 48, non-users 54)	16/22	No separate sample size calculation or sampling for pregnant women. Results will not be generalisable for pregnant women.

SNo	Author	Type of study	Time of study	State	Rural/ Urban	Participants (N0.s)	Quality score*	Potential bias
4	Prinja, 2014 (186)	Cross sectional study (hospital based, public) and Interrupted time series analysis of secondary data	2013	Punjab	Rural and Urban	Hospital- Admitted patients (1,410; users 411, non-users 999); State data- women delivering in public health institutions (Pre-intervention, 5,217; post-intervention, 10,173)	19/22	No separate sample size calculation or sampling for pregnant women while assessing extent of utilisation. Results will not be generalisable for pregnant women. No control series Reporting/ Recording bias: Possibility of incomplete, incorrect, duplicate and missing data in call-centre records Variables indicated in methods are not mentioned in results.
5	Strehlow, 2016 (183)	Cohort study, telephonic survey	2014	Andhra Pradesh, Assam, Gujarat, Karnataka, Meghalaya	Rural and Urban	Pregnant women users (1,684)	20/22	Selection bias: women purposively selected during 6 hours of day time only. Process of sampling in these 6 hours also not described. 5% lost to follow-up. Detection bias: Clinical assessment made by ambulance crew. The quality of recording and diagnostic criteria may have varied from person to person.
'102' ambulance service								
6	Prinja, 2013 (181)	Retrospective analysis of data (Cost effective analysis)	2011	Haryana	Rural and Urban	Call-centre data- Pregnant women users (24,420)	19/22	Reporting/ Recording bias: Possibility of incomplete, incorrect, duplicate and missing data in call-centre records.

SNo	Author	Type of study	Time of study	State	Rural/ Urban	Participants (N0.s)	Quality score*	Potential bias
7	Prinja, 2014 (180)	Case-control study (hospital based, public) and Interrupted time series analysis of secondary data	2011	Haryana	Rural and Urban	Hospital- Patients admitted in emergency (270 users and 270 non-users of ambulance); Call-centre data- Pregnant women users (24,420)	19/22	Included all kind of emergencies in hospital study. Not powered for comparison of pregnant users and non-users while assessing extent of utilisation in hospital study. Reporting/ Recording bias: Possibility of incomplete, incorrect, duplicate and missing data in call-centre records.
Janani express yojana								
8	Sydney, 2014 (187)	Cross-sectional (hospital based, public and private)	2012-13	Madhya Pradesh	Rural and Urban	Hospital- Pregnant women admitted (1,005; users 353, non-users 652)	18/22	Reporting bias: Mothers self-reported the average time in travel of the service utilised
9	Sabde, 2014 (188)	Cross-sectional (hospital based, public and private)	2012-13	Madhya Pradesh	Rural and Urban	Hospital- Pregnant women admitted (468; users 236, non-users 235)	19/22	Reporting bias: Mothers self-reported the average time in travel of the service utilised
EmOC trial								
10	Pasha, 2013 (69, 95)	Cluster randomised trial	2010-12	Maharashtra	Rural	EmOC trial	19/22	Intervention could not be completed in some clusters. Possibility of contamination of control cluster Detection bias: Non-blinded trial can induce bias during assessment

* Strobe for observational studies and CONSORT guidelines for intervention trial

We included a total of 10 studies for analysis: five on '108' services (182-186), two on '102' services (180, 181), two on JEY (187, 188) and one EmOC trial (95). The included studies are briefly described in table-17.

3.2 Characteristics of the included studies

The selected ten studies were published between 2009 and 2016. Of these, nine were observational studies which included three analyses of secondary data, two cross-sectional studies, one cohort study, two hospital based cross-sectional studies, and one case-control study. The tenth study was a cluster randomised trial to evaluate a community-based intervention. Three studies scored moderate (182, 184, 185) and seven scored good on quality assessment.(69, 95, 180, 181, 183, 186-188) Five studies used call-centre data and they have the possibility of incomplete, incorrect, duplicate and missing data.(180, 181, 184-186) None of these five studies mentioned data quality. The studies that depended on data obtained by ambulance technicians were subject to detection and inter-observer bias.(183-185) Other possible biases are mentioned in table-17.

3.3 Type of Interventions

The selected studies mainly described three transport interventions- the '108' ambulance service, '102' ambulance service, and *Janani Express Yojana* (table-18). The '108' and '102' are National ambulance services implemented with slight variations across states.(165)

The '108' ambulance service is a publicly financed and privately operated, call-centre based service operating since 2005. This system was a pioneer in emergency services and has grown to 15 states and two union territories, transporting around 11 million pregnant women in a decade.(83) The '108' ambulances are equipped to provide basic life support and a few also provided advanced life support. A '108' ambulance is manned by a driver and a trained emergency technician. '108' services provide free transport for all type of

emergencies including pregnant women and children. There is no triage for pregnant women and all who call '108', irrespective of any high-risk status or complication, are provided an ambulance. This service transports clients mostly to public facilities and only to private facilities if appropriate public facilities are not available. The destination hospital is decided by the emergency technician, or by the attending doctor/nurse if the journey is an inter-facility transfer.(162, 168, 169, 173-178, 182-186)

The '102' call service is essentially for pregnant women and neonates and has variable operations across the country. *Janani Shishu Suraksha Karyakaram* entitlements e.g. free transfer from home to facility, inter facility transfer in case of referral, and drop back for mother and children, are the key focus of 102 services.(189) In this review we have included the '102' service operational in Haryana, also called '*Haryana Swasthya Vahan Sewa'.* It is a publicly financed and operated ambulance service. It provides free ambulance services to pregnant and postnatal women, and neonates in the first 14 days after birth. Some of these ambulances provide basic life support and some are only vehicles. The service transports clients to public facilities only. Decisions about which facility is taken by the call-centre operator or the treating doctor in cases of referral.(164, 180, 181)

JEY is another transport service provided by a few states. It is a publicly financed and managed call-centre based service operated at district (Madhya Pradesh and Odisha) or at block level (Odisha).(164, 187, 188) It is a free service dedicated to pregnant women and neonates only. The government partners with local taxi companies or other vehicle owners and pays them for every beneficiary transported to a public facility. There is no expert care available in-transit.

Table 18: Characteristics of transport interventions identified in the systematic review

	'108' service	'102' service (Haryana)	*Janani Express Yojana (JEY)*
Client	Primarily for critical cases and also pregnant women	Essentially pregnant women and neonates and few others	Only pregnant women and neonates
Call-centre base	State	District	District/block
User fee	No	Yes, but not for pregnant women	No
Ambulance/ vehicle	Ambulance with basic or advanced life support	Ambulance with basic life support or vehicles only	Empaneled vehicles
Trained technician	Yes	No	No
Destination hospital	Public and few select private hospitals	Public hospitals only	Mostly public hospitals
En-route emergency care	Yes with tele-consultation	No	No
States providing these / similar services*	20 states and union territories	8 states and union territories	Madhya Pradesh, Odisha, Jharkhand, West Bengal
Operations	Publicly financed and privately managed	Publicly financed and managed / privately managed	Publicly financed and managed

*information obtained from national or state health department websites

The EmOC trial in rural Maharashtra trained primary health care workers to screen for high-risk and complication cases, to refer to appropriate facilities, provide pre-referral treatment, arrange for transport, prescribe en-route care and if possible accompany the pregnant women.(69, 95)

3.4 Characteristics of pregnant users of transport interventions

The characteristics of pregnant users (and non-users) reported in the selected studies are described in table-19. Three studies did not describe participant characteristics and thus are not mentioned in this table.(69, 95, 181, 188)

Pregnant women using the '108' service or JEY in the studies described here mostly came from rural or tribal areas, from backward or scheduled castes, and below-the-poverty line strata. Most of the '108', '102' and JEY users visited public facilities.(180, 186, 187) Between 3% and 8% of '108' and JEY users delivered in the ambulance.(183, 187) ASHAs arranged and accompanied 90% of JEY users and only 9% of non-users of JEY.(187)

Most of the transfers by '108' services were for labour pains, followed by haemorrhage, medical conditions and convulsions.(182-185) One study reported that only four percent of users of '108' were transferred between facilities.(184) Another study found that non-users arriving in emergency clinics had a higher proportion of inter-facility transfers.(182) Only 8% of '108' users had caesarean sections.(183) Between 0.1% and 0.2% pregnant users of '108' succumbed to death within a week of transfer.(183, 184) Such data were not available for the '102' and JEY service.

Surendra 2011, found that only 47% of those arriving in an emergency clinic had used the '108' service. Most of the non-users were aware of '108' service. They lived close to the hospital where other transport were more readily available or they lived very far.(182) Sidney 2014 studied use of JEY and found that only 35% used the service, and most of the non-users were not aware of the service.(187)

3.5 Quality of transport for pregnant women

Quality was assessed in terms of response time (call to ambulance reaching the client), total time (call to reaching the hospital), distance travelled, en-route care and costs borne by the users (table-20). Only four studies reported information on outcomes for quality of transportation.

Table 19: Characteristics of pregnant users of transport interventions and outcomes (systematic review)

SNo	Author	N	Mean age, years	Area,%	Caste	Economic status,%	Inter-facility transfer,%	Type of emergency,%	Place of delivery	Impact
'108' ambulance service										
1	Raj, 2009 (184)	121,454 users	23.1	Rural-93, Tribal-3, Urban-4	General-13, Backward-46, Scheduled tribe-13, Scheduled caste-28	Housewife-59, Labourer-38, Others-3	4	Labour pains-60, Abortion/foetal loss-11, Haemorrhage-10, Medical conditions-9, Convulsion-3, Breech presentation-3, Others-3	-	17 (0.02%) of 55,654 died before and 56 (0.1%) died after reaching hospital
2	Jena, 2010 (185)	105,951 users	23	Rural-74, Tribal-7, Urban-19	General-15, Backward-45, Scheduled tribe-14, Scheduled caste-27	Below the poverty line-95	-	Labour pains-90, Abortion/foetal loss-1, Haemorrhage-1, Convulsion-0.5, Delivery in ambulance-2, Others-5.5	-	-
3	Surendra, 2011 (182)	48 users, 54 non-users in emergency ward	-	-	-	-	Users-10 Non-users-61	Users Labour pains-44, Emergency-56; Non-users Labour pains-43, Emergency-57;	-	-

SNo	Author	N	Mean age, years	Area,%	Caste	Economic status,%	Inter-facility transfer,%	Type of emergency,%	Place of delivery	Impact
4	Prinja, 2014 (186)	-	-	-	-	-	-	-	Deliveries in public sector; Pre-intervention (5,217), post-intervention (10,173); No effect of '108' service on deliveries in public sector	.
5	Strehlow, 2016 (183)	1,684 users	23	Rural-79, Tribal-8, Urban-13	General-20, Backward-36, Scheduled tribe-26, Scheduled caste-18	Below the poverty line-70	-	Labour pains-97, Pregnancy induced hypertension-1.3, Convulsion-0.1, Others-2	1,411 delivered; 2.6% at home, 3.2% during transit, 86% in institution and 8.3% at home post discharge	4 died after reaching hospital; 8.2% Caesarean section rate;
'102' ambulance service										
7	Prinja, 2014 (180)	-	-	-	-	-	-	-	Positive effect of '102' service on deliveries in public facilities in two districts. (OR,137; 95% CI 22.4-252.4) and (OR,215; 95% CI,88.5-341.3)	-

SNo	Author	N	Mean age, years	Area,%	Caste	Economic status,%	Inter-facility transfer,%	Type of emergency,%	Place of delivery	Impact
Janani Express Yojana										
8	Sydney, 2014 (187)	1,005; 353 users and 652 non-users	-	User Rural-97, Urban-3 Non-user Rural-67, Urban-33	User General-10, Backward-42, Scheduled tribe-22, Scheduled caste-26 Non-User General-19, Backward-48, Scheduled tribe-10, Scheduled caste-24	User Below the poverty line-46 Non-User Below the poverty line-49	-	-	User Public facility-89% Private facility-3% In transit-8%, Non-user Public facility-88% Private facility-12%	-

Table 20: Quality of transport service for pregnant women in India (systematic review)

S No.	Author	N	Response time, minutes, median (IQR)	Total time, minutes, median (IQR)	Distance, Km, median (IQR)	Cost, INR, median (IQR)*
'108' ambulance service						
2	Jena, 2010 (185)	105,951 users	23 (SD=16) Rural-24 Tribal-25 Urban-18	53 (SD=27) Rural-55 Tribal-57 Urban-42	13.3 (SD=9.9) Rural-14 Tribal-14 Urban-10	Users 0 (0-0)
5	Strehlow, 2016 (183)	1,684 users	24 (16-35) Rural-25 (16-35) Urban-17 (11-28)	65 (50-84) Rural-66 (51-84) Urban-56 (42-73)	15 (9-23) Rural-15 (9-23) Urban-12 (6-17)	Users 0 (0-0)
Janani Express Yojana						
8	Sydney, 2014 (187)	1,005; 353 users and 652 non-users	-	Users- 120 (60-210) Non-users- Public transport-120 (60-180) Hired vehicle-75 (60-150) Own vehicle-60 (30-120)	Users- 11 (6-19) Non-users- Public transport-7 (4-20) Hired vehicle-7 (3-16) Own vehicle-4 (2-11)	Users- 0 (0-0) Non-users- Public transport- 40 (20-100) Hired vehicle-200 (70-500) Own vehicle-50 (0-100)
9	Sabde, 2014 (188)	468; 236 users and 235 non-users	-	Users 120 Non-users 115	Users 10 (6-20) Non-users 7 (2-18)	

Users of the '108' service received an ambulance within a median of 24 minutes, and reached the hospital within a median of 65 minutes, of making a call. (183, 185) Only 6% of women took longer than 2 hours from time of call to the arrival at the hospital.(183) Transportation delay (more than 2 hours from decision to reaching facility) was more prevalent in JEY users (30%) than non-JEY (17%). Sabde 2014, also found that the second delay (Delay in getting transport) was higher among JEY users (47%) than non-users (36%) (OR=1.57, 95% CI= 1.08-2.27).(188) Delays were more likely for pregnant women from

rural areas and those living more than 10 kilometre distance from a health facility. Most delays were due to waiting for a JEY vehicle. There was no difference in delays among referred and non-referred cases.(187, 188)

On route care was provided only by '108' ambulance services. In '108' ambulance services, Strehlow reported that emergency technicians regularly monitored the vital signs and contractions of pregnant women and placed them in the left lateral decubitus position. One woman with severe eclampsia received an injection magnesium sulphate as per the protocol. Emergency technicians delivered 3% women either at home or in the ambulance. During the management of the third stage of labour, they regularly delivered the placenta (75%) and provided uterine massage (88%), however oxytocin was not given to anyone.(183)

3.6 Effectiveness of transport interventions for pregnant women

The EmOC trial did not find any difference in perinatal mortality and stillbirth rate among the intervention and control groups. The intervention only included identification of transport as a component of birth-preparedness but did not report on utilisation of direct transport interventions.(95) Thus we did not assess effectiveness using this study. None of the other studies in this review studied the impact on maternal or early neonatal mortality. Three studies analysed records to assess the effect of transport interventions on deliveries in public health institutions: One study found improvement in use of public health facilities among '102' users (180), while the other two studies did not find any difference among '108' or JEY users or non-users.(186, 187)

3.7 Costs of deploying and operating transport interventions

The infrastructural and operational costs of all three types of interventions are borne by the government. '102' services have potential to recover some costs from non-pregnant

users, while JEY have donations from local donors. A study estimated that operating the '108' service costs INR 17 ($ 0.4) per case transported.(168) Another study estimated operational costs for the '108' service to be INR 11-14, and INR 5-9 for the '102' service per case transferred.(164) Deploying (including purchase costs) an ambulance for the '108' service costs INR 565 per case transported, for '102' service it is estimated between INR 463 and 674, and for JEY this is INR 391.(164) The costs of deployment are more for '108' but these ambulances make many more trips, cover wider geographies and provide a wider range of services than '102' ambulances. Thus the '108' service model is considered more cost-effective than the '102' service model.(164)

4 DISCUSSION

The search found publications on three models of direct intervention for emergency transport of pregnant women in India - the '108', '102' and JEY services. There is insufficient evidence on the effect of these interventions on institutional delivery rates, caesarean section rates or maternal mortality. However, pregnant women transported by the '108' ambulance receive en-route stabilising care which may reduce severe morbidity among mothers and newborns. The '108' ambulance service is considered more cost-effective than others.

In terms of equity, all three interventions served a high proportion of rural and tribal women belonging to low social and economic strata. Studies show that clients living very close and those living very far from the hospital did not prefer '108' or '102' services: Utilisation of these transport services was more likely by clients residing between 10 and 40 kilometres away.(182) It is likely that some remote pockets had poor access to roads and ambulance services. Standards for '108' services require pick-up within 20 minutes

for urban clients and 40 minutes for rural clients, and to reach a health facility within 60 minutes of call.(83, 164) The '108' ambulances achieved these standards for more than half of the clients.(182, 183, 185) The '102' and JEY vehicles transported half of the pregnant women in more than two hours after the call was made, which was equivalent to taking public transport.(83, 187, 188) As pregnant women transported in '108' ambulances have the least travel times of all three interventions, and receive basic obstetric care in transit, the quality of '108' services is better than the '102' and JEY service.

It is estimated that 10% to 30% of all pregnant women in the community use the transport services provided by government.(83, 164) Studies on '108' services show that less than 10% of transported pregnant women used it for obstetric emergency.(183-185) In a study from Andhra Pradesh, only half of the pregnant women attending as an emergency used '108' services, and less than 5% non-users had tried calling '108'.(182) Another study from Uttar Pradesh found that none of the mothers who died, and who had been referred between facilities, used an ambulance service.(37) A study from Madhya Pradesh also found low utilisation rates of JEY and most of the non-users were not aware of this service.(188) It appears that none of the '108', '102' or JEY services are the preferred transport choice for obstetric emergencies and inter-facility transfers.

There have been several enhancements since assessment of transport interventions reported in this review. Currently '108' and '102' services are implemented as National ambulance services and are supported by central and state governments. Almost the whole of the country has either '108' or '102' services.(166) In a few states where both exist they complement each other: The '108' ambulance service is considered a main emergency service for all type of emergencies and the '102' service mainly focuses on

transfer of pregnant women from home to facility, referral from one facility to another, and drop back to home.(166) There are some variations in the use of these toll free numbers by state. The '108' in Tamil Nadu and '102' in Assam provide a dedicated inter-facility transfer service.(167) In the States of Bihar, Kerala, Odisha and Punjab, there is a mix of '108' and '1298' ambulance services, where '1298' provide a paid emergency service. Odisha also has the '102' service.(190) Madhya Pradesh has mix of '108' and JEY services. The '102' service in Haryana is operated publicly while in some states it is operated by private agencies, although operating costs are supported by government.

A study from Punjab, published in 2014, found that use of '108' service was not associated with increase in institutional delivery. However, the authors also note that Punjab had good public and private transportation systems and the state also had high institutional delivery rates before the launch of the '108' service. Thus the '108' service may not show an impact in this state but may have a different effect in a state with poor existing transport systems and poor maternal health indicators.(186)

There was not enough evidence to assess effectiveness of transport interventions in India. Population utilisation proportions across different states or regions will describe the extent of use of these interventions. But population-based comparisons between users and non-users are required in order to analyse preferences of use, reasons for non-use, and impact on maternal and foetal outcomes. Future research is required to understand the patterns and determinants of use of transport services for obstetric emergency and inter-facility transfers, and to assess the high-risk and complication profile of the pregnant women using transport services. The effect of transport interventions should be evaluated for outcomes of pregnancy and early post-partum and neonatal morbidity and mortality.

It is important to assess the coherence and complementarity of two or more models implemented together, in comparison to single transport intervention in a state.

Conclusion

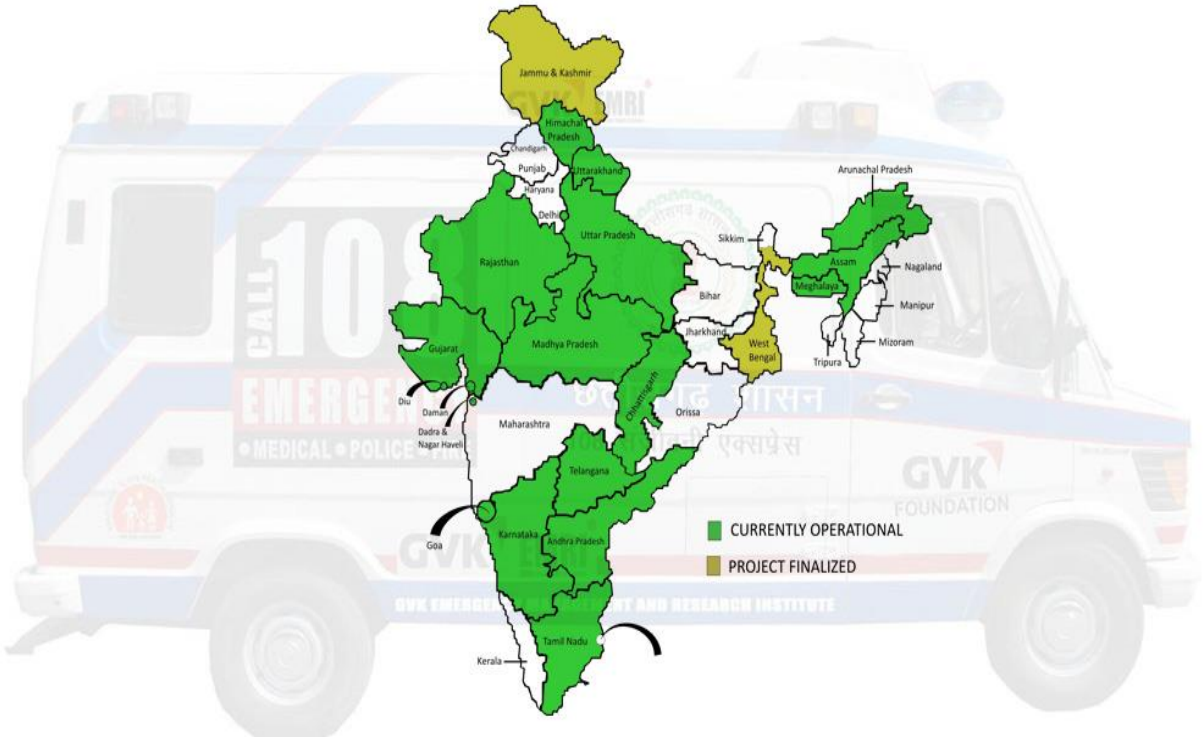
There are several interventions for transportation of pregnant women, exclusively or along with general emergencies, in India. The most prominent interventions are the '108' service, the '102' service, and *Janani Express Yojana*. There is insufficient evidence to assess effectiveness of these interventions on institutional delivery, morbidity or mortality rates. In terms of use of these interventions, a very low proportion of transported women had any obstetric emergency. Use of these services was also uncommon for inter-facility transfers. The limited evidence suggests that these free transport services are likely to be used in higher numbers by poor women from backward castes and rural areas.

Future large scale studies are required to assess the use of transport interventions by pregnant women for normal labour, high-risk and complications, and the determinants of use for obstetric emergency and inter-facility transfer.

CHAPTER 7: '108' AMBULANCE SERVICE FOR PREGNANT WOMEN

The '108' call centre based ambulance system is a free of cost emergency response system, known to be one of the largest public private partnership initiatives across India functioning in 20 states and two union territories (smaller less populated administrative units in India) (figure-16).(166) Although it is designed primarily to attend to patients who are critically ill, as well as victims of trauma and accidents, state governments consider '108' ambulance services the mainstay of transport for pregnant women in both normal labour and emergency.(165) The service is provided in partnership with 3 private institutes. GVK-EMRI is the largest service provider for '108' and operates in 15 states and 2 union territories; Ziqitza Health Care Limited in 4 states; and the Bharat Vikas Group Limited in 1 state.(165)

Figure 16: '108' ambulance service across states and union territories in India



Source: GVK-EMRI website; http://www.emri.in/our-presence/

GVK-EMRI being the first and largest service provider of '108' was chosen for my study. It started operations in August 2005 in Andhra Pradesh and has spread widely since then to 15 states and 2 union territories. The proportion of all '108' transports that were pregnancy related increased from 2% in 2006 to 21% in 2009 in Andhra Pradesh.(184) Across India, this proportion has risen dramatically from 2% in 2005-06 to 41.2% in 2014–15.(83) In 2014-15, GVK-EMRI '108' ambulances transferred about 3.6 million pregnant women to health facilities, which is about two-fifths of all the transfers by '108'.(83)

According to the operational guidelines of the '108' ambulance service there should be one ambulance for every 100,000 population. The ambulances should be well equipped and accompanied by a trained Emergency Medicine Technician (EMT) who provides pre-hospital care before transfer. The EMT is trained to provide emergency care and basic life support in obstetrics. According to guidelines, pregnant women receive, if required, intravenous fluids and oxygen, and magnesium-sulphate and oxytocin after consulting the call centre based medical officer. In case of an imminent childbirth, the EMT assists the delivery at home or en-route, and transfers the mother and child to the nearest health facility.(40) For inter-facility transfers, the EMT consults the call centre based medical officer and the referring health care provider to discuss indication of referral, stability of case to withstand travel, stabilising care required and place of referral (Source: Expert from GVK-EMRI).

In the '108' system every pregnancy is a priority and there is no preference or triage for emergencies in pregnancy or the postpartum period. Ambulances are dispatched to only about 8% of calls for general health care compared to nearly 95% or more for pregnancy related calls.(189)

As a policy '108' ambulances transport clients preferably to the nearest appropriate public health institution. If there is none close to the pick-up site, then they transport the client to the nearest private hospital that is empaneled under the '108' emergency response system. The patient's choice is also considered while making the decision. The '108' ambulance service aims to reach patients/sites within 20 minutes of the call in urban, and within 40 minutes in rural areas, and reach the nearest health facility within 20 minutes following pick-up.(176)

The role of the '108' ambulance service in reducing maternal mortality and severe morbidity is currently unknown. Its contribution in transporting obstetric emergencies and inter-facility transfers in the population is not comprehensively studied. There is also little evidence in literature around the use of such transport interventions and existing health facilities with respect to high-risk, early complications and emergencies in pregnancy.

CHAPTER 8: ANALYSIS OF '108' DATA FOR USE IN OBSTETRIC EMERGENCY AND INTER-FACILITY TRANSFERS, FOR SIX STATES FROM APRIL '13–MARCH '14

Published two papers form analysis of same data set –One on transport of obstetric emergencies and another on inter-facility transfer:

Singh S, Doyle P, Campbell OM, Rao GVR, Murthy GVS. (2016) Transport of pregnant women and obstetric emergencies in India: An analysis of '108' ambulance service system data. BMC Pregnancy and Child birth. 16:318 DOI: 10.1186/s12884-016-1113-7 (Paper-2, Annex-VII)

Singh S, Doyle P, Campbell OM, Rao GVR, Murthy GVS. (2016) Inter-facility transfer of pregnant women using publicly-funded emergency call-centre based ambulance services-Cross-sectional analysis of service logs from five states in India. *BMJ open.* 9;7(6):e015077 DOI: 10.1136/bmjopen-2016-015077 (Paper-3, Annex-VIII)

1 INTRODUCTION

It is estimated that 15% of all pregnancies will encounter complications and 7% will be serious enough to require referral to a higher level of care.(12) The lack of transport, poor communication, high cost and geographical barriers contribute to delay in timely access to emergency obstetric care (EmOC).(12, 191, 192) Delays in reaching EmOC also contribute to maternal morbidity in the form of medical complications, obstetric fistula, disability, and depression, as well as perinatal mortality.(191) Making transport freely available to pregnant women is thus one of the key interventions to reduce such delays.(193)

A large proportion of women delivering in institutions are referred from lower to higher level facilities (Chapter-4).(59, 77, 78) As Inter-facility transfer (IFT) of pregnant women is more likely due to referral for high-risk or complications during pregnancy,

childbirth or post-partum, IFT plays a pivotal role in reduction of maternal morbidity and mortality.(15, 37, 115, 194)

A good process will include prompt arrangement of transport, en-route stabilisation, communication with the referral facility to prepare them for the patient, and appropriate hand-over on arrival. IFT is thus a complex coordinated effort made by the referring health care provider, the en-route attendant, the receiver at the referral health facility, and the referral transport system.(10, 195)

Only a few transport interventions mention improvement in IFTs.(18, 42) Referral transport for IFT may be a) an ambulance based at the referring facility, b) an ambulance called from a referral facility, c) an independent ambulance service, d) other subsidised public or commercial transport, or e) personal or commercial (non-subsidised) transport.(66, 195). In India, most of the peripheral health facilities do not have functional ambulances of their own and if they do, they are not available round the clock.(37, 48, 164) Thus IFT is dependent on other referral transport services.

1.1 Aim and Objectives

The aim of this research was to contribute to knowledge about the use of the '108' ambulance service for pregnant women with obstetric emergencies and IFTs in six states of India- Himachal Pradesh, Telangana, Andhra Pradesh, Chhattisgarh, Gujarat and Assam, using the GVK-EMRI service platform.

The objectives were:

i. To estimate the proportion of all pregnant women in the general population, and the proportion of women with an obstetric emergency, who were transported by the '108' service.

ii. To estimate the proportion of all institutional deliveries in the general population, and the proportion of IFTs, that were transported by the '108' service.

iii. To estimate the proportion of all transfers of pregnant women by '108' that had any a) obstetric emergency, and b) were transfers from one health facility to other.

iv. To describe the characteristics of the women transported, their obstetric complications, and the journeys made.

v. To compare the characteristics of the IFTs and non-IFTs.

2 METHODS

2.1 Study Design

This study was a cross-sectional analysis of '108' ambulance records for the period April 2013 to March 2014 from six states.

Ethics approval for the study was obtained from Indian Institute of Public Health-Hyderabad and London School of Hygiene and Tropical Medicine. (LSHTM Ethics Ref: 9613; IIPHH Ethics Ref: IIPHH/TRC/IEC/009/2014)

2.2 Working definitions

Obstetric emergency, for this study, is defined as any life threatening medical complication related to pregnancy or a medical condition complicating pregnancy- during pregnancy, labour or child-birth, or after (within 42 days of termination of pregnancy).

Inter-facility transfer (IFT), for this study, was defined as any transfer of a pregnant woman from one health facility to another health facility on the advice of a health care provider, using a '108' ambulance. All other transfers of pregnant women to health facilities using '108' ambulances were defined as 'non-IFT'. These mostly included transfers from home to facility.

A pregnancy-related call is defined as any call from, or for a pregnant woman, in labour or in the post-partum period for antenatal care, abortion related care, labour pains, child-birth, post-birth care, or any complication in these periods.

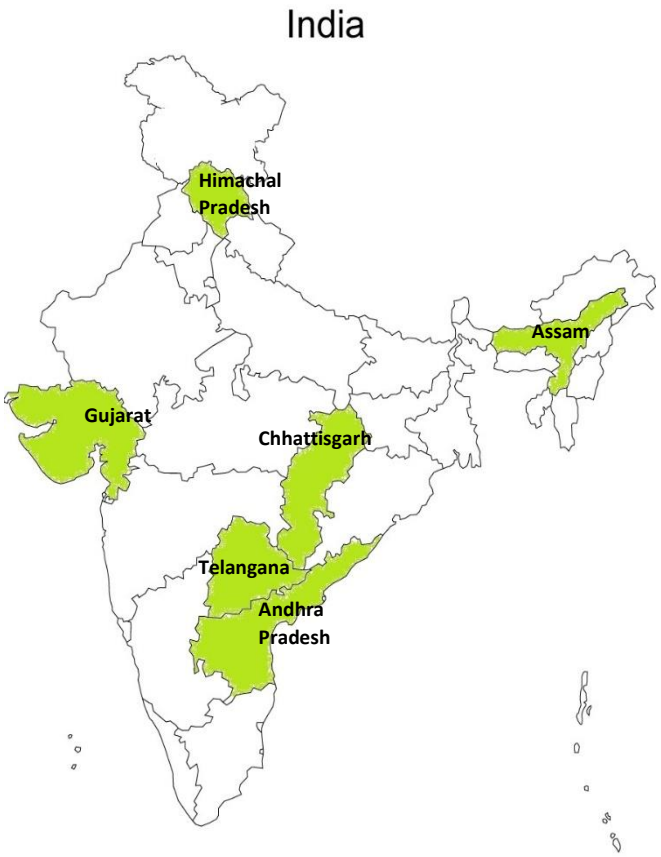
2.3 Study population

Pregnant women (or their relatives/friends) who called '108' between 1st April 2013 and 31st March 2014 in six states in India where GVK-EMRI had been fully functional for more than 3 years were included in this analysis. One state was selected randomly from North, South, Central, West and East of India (Himachal Pradesh, Andhra Pradesh and Telangana, Chhattisgarh, Gujarat and Assam) (figure-17). The '108' data received from Assam did not have information on IFT and was thus dropped from the analysis of IFT and its determinants.

2.4 Obtaining data and data management

GVK-EMRI emergency response centre records basic information about the client when he/she calls '108' for an ambulance. Later, after examination by the EMT and once the case is transported, the EMT reports to the emergency response centre to provide more information on social-economic status, clinical condition, and treatment provided en-route, and details of journeys undertaken. Formal permission for use of data was obtained from GVK-EMRI and respective state offices.

Figure 17: States included in the study to assess '108' ambulance service



Anonymised information on '108' calls from 1st April 2013 to 31st March 2014 was obtained from the GVK-EMRI emergency response centre database. No personal identifiers were recorded. Data were linked with the incident/case id recorded by the call centre. Variables of interest for the secondary data analysis were: type of call; ambulance assigned or not; assigned ambulance used or not; type of emergency; IFT; age of pregnant woman; social class (based on Indian caste system); economic class (below or above poverty line as mentioned by the user); region (rural or urban); type of emergency; time of call; day of call; time taken by ambulance to reach the client; time taken to reach the health facility; distance travelled; and mortality.

Data were extracted onto Excel sheets, and converted to STATA 10.0 files. Data were inspected to assess consistency, range, and missing data. Any gross issue related to the

quality of records was noted, and records with improbable entries were excluded from analysis. Data were recoded wherever needed. About 1-5% data was found to be missing in most of the variables. However for social-class 2-20% and economic status 10-90% of the data was missing. There were few data inconsistencies. Some possible wrong entries were noted in time and distance variables but they constituted less than 0.5% of all data. These records were excluded from analyses. The states included in the study also transported neonates in the post-partum period, and in Telangana and Andhra Pradesh mothers and newborns were also transported back from hospital to home. This information was extracted from 3 variables and text remarks within the dataset, and these cases were excluded from analysis.

A new variable relating to obstetric emergency was generated, based on the type of emergency recorded. The '108' annual reports also classify delivery by EMT at home or in the ambulance, suicide/ injury/ accidents and others as emergencies. Deliveries assisted by EMTs did not have information on whether these were normal delivery cases or had any complication. EMTs were trained only to handle normal deliveries. I was not sure whether suicide/ injury/ accidents were classified as medical conditions due to pregnancy, or complicated by pregnancy or otherwise, as there was no further information on these in the EMT logs. Since I could not reliably decide on these cases as obstetric emergences I did not classify them as obstetric emergency.

Districts within states were stratified into high priority districts and non-high priority districts. High priority districts are identified by the Government of India as the lowest quartile of districts (or tribal districts) in each state with respect to maternal and child health indicators (including institutional delivery rate, maternal mortality and neonatal mortality rates among total 16 indicators).(196)

2.5 Analysis

i. Characteristics of state populations and pregnant women who requested '108' assistance

Socio-demographic information for the populations in six states were collated from the Census 2011, the Sample Registration System (SRS), District Level Household Survey (DLHS), and Annual Health Survey (AHS) using information as close to the study period dates as possible. Information on pregnancy related calls to '108' was extracted from '108' call centre data (2013-2014) and presented according to state.

ii. Estimation of proportions of all pregnant women, institutional deliveries, and women with obstetric emergencies who made use of the '108' service within states

For each state, the number of pregnancies expected in the study period was estimated as [population (rural) X crude birth rate (rural) X 1.1 X 1000] + [population (urban) X crude birth rate (urban) X 1.1 X 1000]. The population data were obtained from the 2011 census and the crude birth rates from the Sample Registration System 2013. The multiplier 1.1 is used to account for an estimated 10% of the pregnancies which ended in abortions or intra-uterine deaths.(197)

The number of expected institutional deliveries in the study period for each state was estimated as [Estimated number of pregnancies (rural) X institutional delivery rate (rural) X 100] + [Estimated number of pregnancies (urban) X institutional delivery rate (urban) X 100]. Institutional delivery rates include live births and stillbirths. The institutional delivery rate for each state was obtained from DLHS-4 and AHS-2 surveys.

The number of obstetric emergencies expected in the study period was estimated as [estimated no. of pregnancies X 0.15], using 15% as the estimated overall prevalence of obstetric emergencies.

The number of pregnant women who were transported by '108' as recorded in the call-centre database were compared with these estimated numbers for each state by calculating proportions.

iii. Characteristics of the women transported, their obstetric complications, and the journeys made, for each state

Socio-economic information on women who were transported using '108' ambulances was collated and presented by state. Clinical information on their obstetric emergencies, and the journeys taken by women experiencing obstetric emergencies, was also collated and presented according to state.

iv. Comparison of the characteristics of the inter-facility transfers and non-inter-facility transfers

The characteristics of the women transported, distances travelled and the time taken by '108' ambulances, were described for both IFT and non-IFT journeys. The association between socio-demographic and clinical variables and the outcome (IFT vs no-IFT) was investigated using bivariate and multivariate logistic regression.

Social caste and economic class data were missing in 55% and 95% of observations in the state of Chhattisgarh, and 14% and 22% in Himachal Pradesh. Given the nature of the variables we decided that it was likely that the data were missing not at random, and therefore multiple imputation was considered inappropriate.(198) In order to investigate possible selection bias resulting from missing data, I performed a complete case analysis of IFT for each state and all states combined, supplemented by a series of sensitivity analyses. The first sensitivity analysis involved running model with and without states of Chhattisgarh and Himachal Pradesh. Presence or absence of these states did not substantially change the pattern of results. The second sensitivity analysis was performed by running a model with and without social caste and economic class for all states

combined (total) and for individual states. The presence or absence of these variables did not substantially change the magnitude of the pattern of results for the total and for states (except Chhattisgarh). For the main analysis (all states combined) I thus included social caste and economic class variables and excluded any data from Chhattisgarh. Models for individual states (except Chhattisgarh) also include social caste and economic class.

3 RESULTS

3.1 Study Populations

As background information, the characteristics of states with respect to population size, fertility and mortality were assembled and are presented in table-21. The study states had population sizes ranging from 6 million to 60 million and had different social compositions (table-21). The proportion of rural/tribal population ranged from 61% in Telangana to 90% in Himachal Pradesh, while scheduled castes and tribes, together, ranged from 22% in Andhra Pradesh and Gujarat to 43% in Chhattisgarh. (The '108' call centre data may not accurately capture rural and tribal discretion, thus we decided to combine it. We combined rural and tribal for population estimates also to be able to compare '108' data with population estimates.)

The crude birth rate was lowest in Himachal Pradesh (16 per 1000 population) and highest in Chhattisgarh (25 per 1000 population). The states also varied in institutional delivery rates from 40% in Chhattisgarh to 94% in Telangana, and Maternal Mortality Ratio from 244 in Chhattisgarh to 92 per 100,000 live births in Telangana and Andhra Pradesh. Chhattisgarh and Assam are among the poor performing states in maternal and child health.

Table 21: Demographic characteristics and use of '108' ambulance in the six study states

	Andhra Pradesh	Assam	Chhattisgarh	Gujarat	Himachal Pradesh	Telangana
Demographic Characteristics						
Total Population*, N	49,386,799	31,169,272	25,540,196	60,383,628	6,856,509	35,193,978
Rural/tribal, %	70.4	85.9	76.8	57.4	90.0	61.3
Urban, %	29.6	14.1	23.2	42.6	10.0	38.7
Scheduled caste*, %	17.1	7.2	12.8	6.8	25.2	15.4
Scheduled tribe*, %	5.33	12.5	30.6	14.8	5.7	9.3
Crude birth rate per 1000 population**	17.5	22.5	24.5	21.1	16.2	17.5
Rural/tribal	17.9	23.7	26.0	22.5	16.7	17.9
Urban	16.6	15.6	18.0	18.7	11.0	16.6
Institutional delivery rate (2012-13)***, %	88.5	65.9	39.5	78.1	77.8	94.1
Rural/tribal, %	86.1	62.9	35.4	73.1	76.4	92.1
Urban, 5	94.8	84.5	58.4	86.5	92.1	97.3
MMR per 100,000 live births (2011-13)**	92	300	244	112	-	92
NMR per 1,000 live births (2012-13)**	25	27	31	26	25	25
No. of Ambulances under '108'[#], N	468	380	240	506	171	334
Region	Tribal pockets	Large Tribal; hilly pockets	Large Tribal; hilly pockets	Tribal pockets	Majority hilly	Tribal pockets
Pregnancy-related '108' Calls- April 2013 to March 2014						
Pregnancy related calls to '108', N	172,076	Not available[##]	65,243[$]	261,702	25,016	122,619
Area						
Rural/tribal, %	76.5	Not available[##]	92.8	88.5	80.9	74.0
Urban, %	23.3		7.2	11.5	6.2	25.9
Missing, %	0.2		0.0	0.0	12.9	0.2
Use of ambulance						
Ambulance used, %	89.8	Not available[##]	95.2	99.4	99.8	90.0
Ambulance not used, %	8.2		3.2	0.0	0.2	7.8
Ambulance not assigned, %	2.0		1.6	0.6	0.0	2.2

Source- *Census 2011; ** Sample Registration System 2013- Separate data for Telangana and Andhra Pradesh not available; *** DLHS (2012-13) / AHS (2011-12); [#] GVK-EMRI annual report for period April 2013- March 2014. [##] Information on number of calls made to '108' in Assam not known; [$]In Chhattisgarh '102' ambulance service took over from October 2013 – March 2014.

3.2 Pregnancy related calls to '108'

A total of 646,656 pregnancy related calls were received by the '108' call centre in five states (excluding Assam) during the study period April 2013 to March 2014. In Chhattisgarh, '108' worked to full capacity for transporting pregnant women until September 2013, when the '102' ambulance service took over and the transports by '108' reduced to 1/10th of the previous transfers in October 2013 – March 2014.

A higher proportion of calls were from rural than urban areas in all the states except Himachal Pradesh, even higher than expected from population proportions. For example, the rural populations in Chhattisgarh and Gujarat were 77% and 57% respectively (table-21) while the proportion of '108' service calls from rural areas in these two states were 93% and 89% respectively (table-21).

Ambulances were assigned for more than 98% of the pregnancy related calls overall. Table-21 shows that the proportion of calls resulting in an ambulance not being assigned, and an ambulance not being used despite being assigned, was highest in Telangana and Andhra Pradesh. The proportion of callers who were not assigned an ambulance did not vary between rural and urban populations, or between IFT and non-IFT calls (data not shown). The proportion who did not use an ambulance (despite being assigned) was higher amongst urban (5%) compared to rural (3%) populations and in IFT (6%) compared to non-IFT (4%) callers.

3.3 Estimated proportions of pregnant women, institutional deliveries and obstetric emergencies, transported by '108'

Table-22 presents estimates for the number of pregnant women, institutional deliveries and obstetric emergencies in the general population, and the proportion of these transported using '108' ambulances. In total 757,697 pregnant women were transferred

to hospitals using '108' ambulances in the study year, which is 17% of the estimated pregnancies and 21% of the estimated institutional deliveries for all the study states combined. The estimated proportion of pregnant women transported by '108' ranged from a low of 9% in Chhattisgarh to a high of 21% in Himachal Pradesh. The estimated proportion of institutional deliveries transported by '108' ranged from 17% in Telangana to 29% in Assam.

Over all the states, an estimated 4.3% of obstetric emergencies were transported by '108'. The highest estimated proportion of obstetric emergencies transported was in Himachal Pradesh (12.7%) and Gujarat (7.2%) (table-22). For other states the estimated proportion of obstetric emergencies transported was 3.5% or less.

3.4 Estimated proportions of Inter-facility transfers by '108'

Of the estimated institutional deliveries, '108' transported only 1.2% (34,993) women between facilities across states (excluding Assam). This proportion was highest in Himachal Pradesh (3.0%) followed by Andhra Pradesh (1.7%), Telangana (1.4%), Chhattisgarh (0.7%) and lowest in Gujarat (0.6%) (table-22).

3.5 Characteristics of pregnant women transported by '108'

Table-23 describes the characteristics of pregnant women transported by the '108' service. The majority were 20-35 years old. A higher proportion of users belonged to scheduled caste and scheduled tribes compared to the census population in all the states, except Chhattisgarh and Assam. Almost all the users in Telangana and Andhra Pradesh, 85% in Assam, and about three fifths in Himachal Pradesh and Gujarat were classified as belonging to below the poverty line category. The majority of the pregnant women used '108' ambulances for normal labour pains or other (non-emergency) reasons.

Table 22: Estimated proportion of pregnant women transported to hospitals/ health centres by '108', April 2013 to March 2014

	Total	Andhra Pradesh	Assam	Chhattis -garh[$]	Gujarat	Himachal Pradesh	Telangana
Estimated number of pregnancies in the population [a], N	4,585,400	950,696	773,480	678,217	1,387,021	121,638	673,508
Estimated number of institutional deliveries in the population [b], N	3,431,397	842,109	509,723	267,896	1,083,264	94,634	633,771
Estimated number of obstetric emergencies in the population [c], N	687,810	142,730	116,022	101,733	208,053	18,246	101,026
Proportion of all pregnancies transported by '108' [d], %	16.5	15.5	19.3	9.0	19.5	20.5	15.7
Proportion of all institutional deliveries transported by '108' [e], %	22.1	17.5	29.3	22.7	24.9	26.3	16.6
Proportion of all obstetric emergencies transported by '108' [f], %	4.3	3.4	3.5	2.6	7.2	12.7	3.5
Proportion of all institutional deliveries that were transported by '108' for inter-facility transfers [g], %	1.2	1.7	-	0.7	0.6	3.0	1.4

[a] [population (rural) X crude birth rate (rural) X 1.1 X 1000] + [population (urban) X crude birth rate (urban) X 1.1 X 1000]; Using Census populations and crude birth rates from Sample Registration Survey in respective states

[b] [Estimated number of pregnancies (rural) X institutional delivery rate (rural) X 100] + [Estimated number of pregnancies (urban) X institutional delivery rate (urban) X 100]; Institutional delivery rates include live births and stillbirths. Using institutional delivery rates from District Level Household Survey / Annual Household Survey in respective states

[c] Estimated number of pregnancies X 0.15; Assumption that 15% of pregnancies may develop any complication that may need emergency obstetric care.

[d] Number of pregnant women transported by '108'/Estimated number of pregnancies in the population([a])

[e] Number of pregnant women transported by '108'/Estimated number of institutional deliveries in the population([b])

[f] Number of pregnant women transported by '108' for obstetric emergency / estimated number of obstetric emergencies in the population([c])

[g] Number of pregnant women transported between facilities (IFTs) by '108'/ estimated number of institutional deliveries in the population([b])

[$]In Chhattisgarh '102' ambulance service took over from '108' service from October 2013 to March 2014. Thus number of beneficiaries of '108' and proportions may be underestimation of utilisation for annual estimates.

Between 2.7% and 9.3% of transported pregnant women had an obstetric emergency. Between 2.4% of pregnant women transported by '108' ambulances in Gujarat, and 11.3% in Himachal Pradesh, were referred and transported from one health institution to another.

Less than 5% delivered at the pick-up site or in the ambulance en-route. Two hundred and forty two women (32/100,000 transported women) died before the ambulance reached the pick-up site. The proportion of pregnant women who died before arrival of '108' ambulance was higher in Chhattisgarh (148/100,000 transported women) compared to other states.

3.6 Obstetric emergencies transported by '108'

Table-24 presents further detail on the type of obstetric emergency. The most common obstetric emergency was abnormal presentation of foetus (Telangana, Andhra Pradesh and Gujarat), bleeding in pregnancy (Himachal Pradesh and Assam), and medical conditions complicating pregnancy in Chhattisgarh. Among pregnant women transported for obstetric emergency, IFTs ranged from 4.5% in Gujarat to 25.5% in Himachal Pradesh.

Distances travelled and time taken by '108' ambulances to transfer pregnant women with emergency are shown in table-24 and figure-18. Ambulances travelled less than 10-11 kilometres to reach half of the pregnant women with emergency across all the study states. However median distances to the health centre were between 10 kilometres in Chhattisgarh to 21 kilometres in states of Telangana and Andhra Pradesh. The time taken in travel to the pregnant women and to the hospital was lowest in Chhattisgarh and Gujarat. Although distances in Himachal Pradesh were not the highest, the travel time was highest compared to the other states. The median time from call to '108' and reaching a hospital ranged from 60 minutes to 90 minutes in all the states. The 75th percentile in Himachal Pradesh was high at 150 minutes.

Table 23: Characteristics of pregnant women transported to hospitals by '108', April 2013 to March 2014

	Total N=757,697	Andhra Pradesh N=147,374	Assam N=149,138	Chhattisgarh N=60,810	Gujarat N=270,071	Himachal Pradesh N=24,923	Telangana N=105,381
Obstetric emergency, %	4.3	3.3	2.7	4.4	5.6	9.3	3.4
Inter-facility transfers, %	5.8	9.9	Not available	3.2	2.4	11.3	8.7
Age, %							
<20 years	4.3	4.9	8.1	5.8	1.7	5.5	3.6
20-35 years	87.7	94.2	87.6	92.7	79.7	91.2	95.6
>35 years	0.8	0.6	0.8	1.0	1.0	1.5	0.5
Missing	7.2	0.3	3.5	0.5	17.6	1.8	0.3
Social caste, %							
General caste	9.1	10.8	3.3	1.6	12.8	29.6	5.2
Other backward	32.2	43.5	16.7	20.3	35.0	9.4	43.2
Scheduled caste	18.6	33.9	8.8	6.8	11.0	32.7	33.8
Scheduled tribe	23.0	11.0	11.7	17.5	41.0	5.9	17.2
DK/ missing	17.0	0.7	59.4	53.8	0.1	22.4	0.7
Economic class, %							
BPL	71.7	98.5	85.0	4.6	55.7	57.2	98.3
Others	18.9	0.4	10.6	0.1	44.0	28.8	0.5
DK/ missing	9.4	1.1	4.4	95.3	0.2	14.0	1.2
Area, %							
Rural/tribal	84.1	78.1	Not available	92.7	88.6	80.9	76.9
Urban	15.3	21.7		7.3	11.4	6.3	23.1
Missing	0.6	0.2		0.0	0.0	12.8	0.1
Delivery en-route, %							
At pick up site	1.4	0.7	1.7	2.7	1.7	1.5	0.6
In ambulance	1.1	0.7	1.8	1.5	0.9	3.3	0.7
Died before ambulance reached (per 100,000)	32	26	15	148	33	12	19
Type of hospital, %							
Public	73.7	71.4	Not available	88.2	70.1	94.7	72.8
Private	18.8	16.0		3.2	27.4	2.5	13.7
Missing	7.5	12.7		8.6	2.5	2.8	13.5

BPL= Below-poverty-line ; IFT= Inter-facility transfer ; DK= Don't know

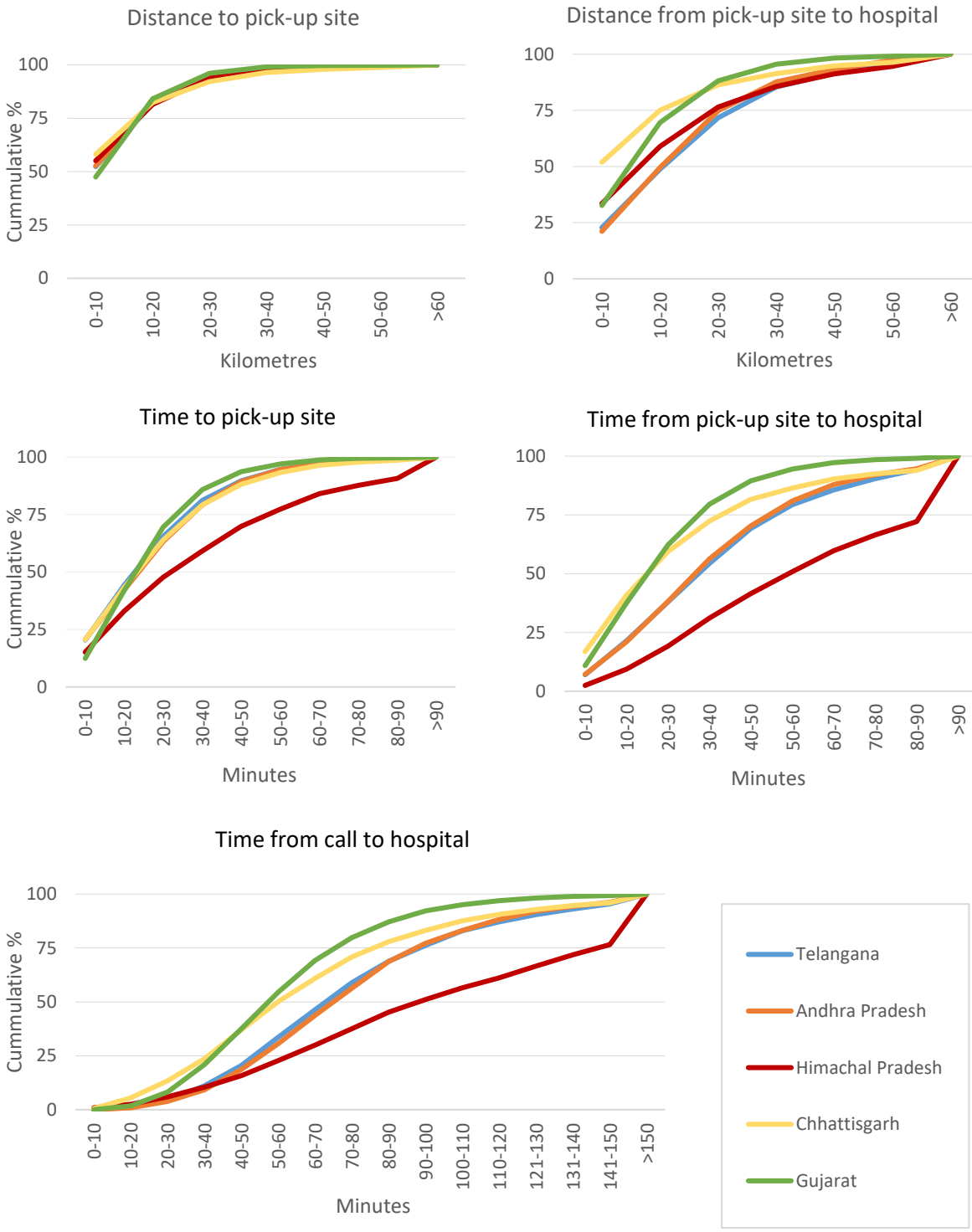
Table 24: Characteristics of obstetric emergencies transported by '108', April 2013 to March 2014

	Total N=32,488	Andhra Pradesh N=4,837	Assam N=4,040	Chhattisgarh N=2,660	Gujarat N=15,065	Himachal Pradesh N=2,316	Telangana N=3,570
Area, %							
Rural/tribal	72.1	75.4	Not available	91.6	86.1	77.3	72.3
Urban	14.6	24.3	-	8.4	13.9	11.7	27.6
Missing	0.9	0.3	-	0.0	0.0	11.1	0.1
Type of transfer, %							
IFT	9.0	16.2	Not available	13.1	4.5	25.5	14.9
Non-IFT	91.0	83.8	-	86.9	95.5	74.5	85.1
Type of complication, %							
Abortion	4.8	6.2	7.1	4.3	2.7	12.6	3.8
Abnormal Presentation	39.0	31.4	19.5	26.8	55.6	5.0	32.4
Bleeding in pregnancy	21.9	16.9	44.1	5.0	16.3	57.8	16.7
Eclampsia/ convulsion	4.2	7.7	9.8	2.4	1.5	2.6	7.1
Fever	1.3	2.8	0.0	1.8	0.9	0.0	2.6
Foetal loss	1.6	2.2	0.7	8.5	0.4	1.8	2.0
Medical condition complicating pregnancy	12.7	16.0	0.9	45.6	6.7	15.4	20.5
Previous caesarean	8.0	9.9	10.3	4.8	8.1	2.8	8.2
Precious pregnancy	6.5	6.8	7.6	0.8	7.8	2.1	6.7
Distance call to site,* Kilometres ; Median (IQR)	Not estimated	10 (3-18)	Not available	8 (1-17)	11 (6-17)	9 (1-17)	10 (3-18)
Distance site to hospital,* Kilometres ; Median (IQR)	Not estimated	21 (12-31)	Not available	10 (4-20)	15 (9-23)	17 (7-30)	21 (11-32)
Time call to site,* minutes ; Median (IQR)	Not estimated	24 (12-37)	Not available	23 (12-37)	23 (15-33)	32 (15-56)	23 (12-35)
Time site to hospital,* minutes ; Median (IQR)	Not estimated	37 (23-55)	Not available	25 (14-43)	24 (15-36)	60 (35-95)	38 (23-56)
Time call to hospital,* minutes ; Median (IQR)	Not estimated	75 (55-97)	Not available	60 (41-86)	57 (43-75)	91 (63-146)	73 (54-98)

IFT= Inter-facility transfer; IQR=Interquartile range

*N varies- excludes deliveries by EMT that were not transported or missing values

Figure 18: Distance and time travelled by '108' ambulance for women with obstetric emergency



3.7 Inter-facility and non-inter-facility transfers by '108'

Of the pregnant women transferred by '108' ambulances, 34,993 (6%) had an IFT (table-25). The proportion of IFTs among women transported by '108' was highest in Himachal Pradesh (11%) followed by Andhra Pradesh (10%), Telangana (9%), Chhattisgarh (3%) and Gujarat (2%). Overall, IFTs were made up of a higher proportion of younger women, women from backward caste, belonging to below-the-poverty-line and from urban areas compared to non-IFTs. A similar pattern was observed across all the states except in Himachal Pradesh where IFTs had lower proportion of women from below-poverty-line strata compared to non-IFTs (table-25). Delivery en-route or in the ambulance was less likely among IFTs compared to non-IFTs across all states.

The IFTs (8%) had higher proportion of pregnant women who had an obstetric emergency compared to non-IFTs (4%). Himachal Pradesh had highest proportion of obstetric emergencies transferred for both IFT (21%) and non-IFT (8%). Andhra Pradesh had the lowest proportion of obstetric emergencies transferred for IFT (5%) and non-IFT (3%). IFTs had higher proportions of 'bleeding in pregnancy' cases across all the states and 'medical conditions complicating pregnancy' in Himachal Pradesh and Chhattisgarh (table-26). In Telangana and Andhra Pradesh, some IFTs (0.5% and 0.2%) and non-IFTs (8.4% and 0.5%) were for antenatal women requiring check-ups at higher institutions (data not shown).

Table 25: Demographic characteristics of users of '108' ambulance service for IFT and non-IFT in study states, April 2013 to March 2014

	Total		Andhra Pradesh		Chhattisgarh		Gujarat		Himachal Pradesh		Telangana	
	IFT,% (N=34,993) [5.8%]	Non-IFT,% (N=573,566)	IFT,% (N=14,574) [9.9%]	Non-IFT,% (N=132,800)	IFT,% (N=1,929) [3.2%]	Non-IFT,% (N=58,881)	IFT,% (N=6,562) [2.4%]	Non-IFT,% (N=263,509)	IFT,% (N=2,809) [11.3%]	Non-IFT,% (N=22,114)	IFT,% (N=9,119) [8.7%]	Non-IFT,% (N=96,262)
Age group (years)												
≤19	4.1	3.4	5.0	4.8	7.1	5.8	2.3	2.0	4.4	5.7	3.5	3.6
20 – 24	58.7	56.5	64.9	65.7	54.9	56.4	52.0	51.9	48.3	51.6	58.6	58.9
25 – 30	28.1	30.6	24.0	24.9	25.0	27.9	30.1	33.2	34.5	32.0	31.4	32.2
30 – 34	6.5	7.2	4.2	3.3	8.9	7.2	11.3	9.9	9.4	8.0	4.8	4.1
≥35	2.6	2.3	1.9	1.2	4.1	2.7	4.3	3.0	3.4	2.7	1.7	1.2
Total non-missing	(32,538) 100	(551,568) 100	(13,105) 100	(120,155) 100	(1,914) 100	(58,591) 100	(6,562) 100	(263,508) 100	(2,779) 100	(21,694) 100	(8,178) 100	(87,620) 100
missing	(2,455) 7.0	(21,988) 3.8	(1,469) 10.1	(12,645) 9.5	(15) 0.8	(290) 0.5	0.0	0.0	(30) 1.1	(420) 1.9	(941) 10.3	(8,642) 9.0
Social caste												
General caste	12.2	11.3	10.8	10.9	3.7	3.5	14.8	12.8	37.3	38.2	7.1	5.0
Other backward	40.0	38.5	41.7	44.1	48.5	43.8	38.3	35.0	17.4	11.5	43.4	43.5
Scheduled caste	29.1	22.1	34.7	34.1	14.3	14.7	11.2	11.1	37.2	42.8	32.2	34.2
Scheduled tribe	18.7	28.2	12.8	10.9	33.6	38.1	35.8	41.2	8.1	7.6	17.3	17.3
Total non-missing	(32,800) 100	(535,328) 100	(14,400) 100	(131,924) 100	(652) 100	(27,427) 100	(6,551) 100	(263,204) 100	(2,201) 100	(17,148) 100	(8,996) 100	(95,625) 100
DK/ missing	(2,193) 6.3	(38,238) 6.7	(174) 1.2	(876) 0.7	(1,277) 66.2	(31,454) 53.4	(11) 0.2	(305) 0.1	(608) 21.6	(4,966) 22.5	(123) 1.3	(637) 0.7
Economic class												
BPL	87.7	75.9	99.7	99.6	96.7	97.0	54.2	55.9	62.7	67.0	99.5	99.5
Others	12.3	24.1	0.3	0.4	3.3	3.0	45.7	44.1	37.3	33.0	0.5	0.5
Total non-missing	(32,296) 100	(511,447) 100	(14,357) 100	(131,391) 100	(61) 100	(2824) 100	(6,540) 100	(262,991) 100	(2,395) 100	(19,041) 100	(8,943) 100	(95,200) 100
DK/ missing	(2,697) 7.7	(62,119) 10.8	(217) 1.5	(1,409) 1.1	(1,868) 96.8	(56,057) 95.2	(22) 0.3	(518) 0.2	(414) 14.7	(3,073) 13.9	(176) 1.9	(1,062) 1.1
Area												
Rural/tribal	68.7	85.6	67.4	79.5	92.1	92.7	62.8	89.3	75.9	95.2	67.6	77.8
Urban	31.3	14.4	32.6	20.5	7.9	7.3	37.2	10.7	24.1	4.8	32.4	22.2
Total non-missing	(34,910) 100	(570,042) 100	(14,555) 100	(132,510) 100	(1,929) 100	(58,881) 100	(6,562) 100	(263,509) 100	(2,770) 100	(18,952) 100	(9,094) 100	(96,190) 100
Missing	(78) 0.2	(3,524) 0.6	0.1	(290) 0.2	0.0	0.0	0.0	0.0	(39) 1.4	(3,162) 14.3	(25) 0.3	(72) 0.1
Died before ambulance Reached	0.07	0.04	0.04	0.02	0.36	0.14	0.02	0.03	0.0	0.01	0.02	0.02
Delivery en-route												
At pick up site	0.3	1.4	0.2	0.8	1.2	2.8	0.5	1.7	0.2	1.7	0.2	0.7
In ambulance	0.6	1.0	0.4	0.7	0.8	1.5	0.6	0.9	1.7	3.5	0.4	0.7

IFT= Inter-facility transfer ; non-IFT = non-inter-facility transfer

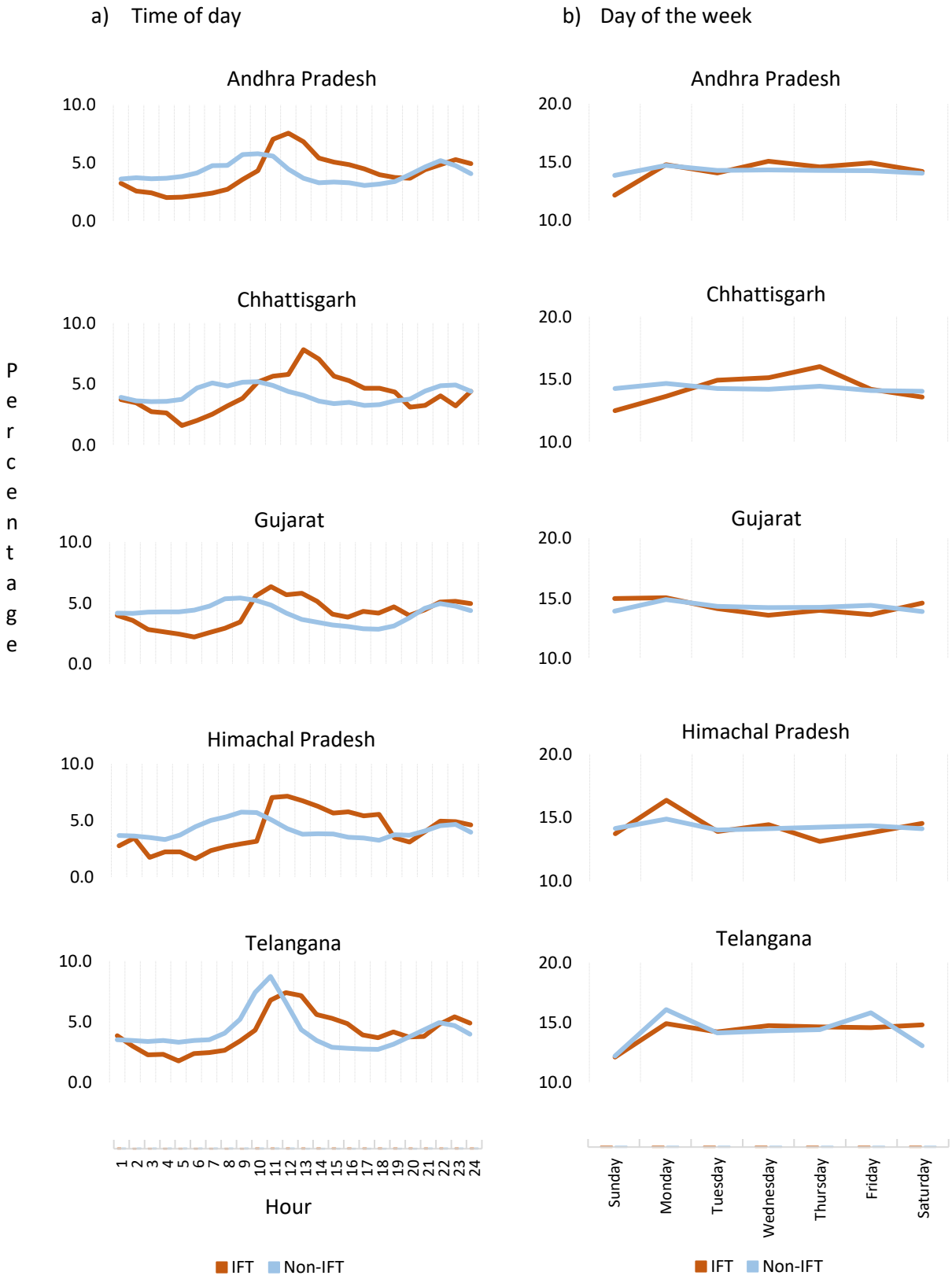
About 86% of all transfers were to government or government supported hospitals. This figure was highest in Himachal Pradesh (97%) and lowest in Andhra Pradesh where around 82% of women were transferred to government hospitals (table-26). In Chhattisgarh transfers to government or supported hospitals were 9% more among non-IFTs than IFTs (97% and 88%). The proportions of transfers to government or government supported hospital were similar in IFTs and non-IFTs overall and in other states. However, with type of government facility, across the states, half of the IFTs were to district level secondary or tertiary hospitals while non-IFTs were to Sub-district Area or Civil hospitals or CHCs. Gujarat reported highest percentage of transfers to middle level facilities. Himachal Pradesh had more transfers to Civil-hospitals or higher (table-26).

The median distances travelled and time taken by '108' ambulances to transfer pregnant women are shown in table-26. Ambulances travelled less than 4 kilometres to reach half of the pregnant women for IFTs across four states but up to 10 kilometres in Andhra Pradesh. For non-IFTs, ambulances travelled farther (between 9 and 12 kilometres) to reach half of the pregnant women. Among IFTs median distances from pick-up site to destination facility were between 16 kilometres in Chhattisgarh to 32 kilometres in Himachal Pradesh, but nearer in non-IFTs (between 8 and 32). The median time taken for the ambulance to travel to the pick-up site for IFTs was between 10 minutes and 15 minutes for four states but longer (24 minutes) in Andhra Pradesh. The median time taken for travel from the referring to the referral facility was less than 40 minutes in Andhra Pradesh, Chhattisgarh and Gujarat but longer for Telangana (48 minutes) and Himachal Pradesh (83 minutes). For non-IFT, these times were about 30 minutes each, except for Himachal Pradesh where travel times were longer (table-26).

Table 26: Characteristics of transfers for IFT and non-IFT by states, April 2013 to March 2014

	Total		Andhra Pradesh		Chhattisgarh		Gujarat		Himachal Pradesh		Telangana	
	IFT (N=34,993)	Non-IFT (N=573,566)	IFT (N=14,574)	Non-IFT (N=132,800)	IFT (N=1,929)	Non-IFT (N=58,881)	IFT (N=6,562)	Non-IFT (N=263,509)	IFT (N=2,809)	Non-IFT (N=22,114)	IFT (N=9,119)	Non-IFT (N=96,262)
Obstetric emergency, %	8.4	4.4	5.4	3.1	18.0	3.9	10.4	5.5	21.0	7.8	5.8	3.2
Abnormal presentation	1.5	2.0	1.0	1.0	1.3	1.2	3.2	3.1	0.7	0.4	1.3	1.1
Bleeding in pregnancy	3.5	0.9	2.0	0.6	1.6	0.4	4.5	1.0	14.1	5.6	2.1	0.6
Eclampsia/ convulsion	0.7	0.1	0.6	0.2	0.7	0.1	0.6	0.1	1.1	0.1	0.8	0.2
Foetal loss	0.2	0.1	0.1	0.1	0.6	0.4	0.1	0.02	0.4	0.1	0.1	0.1
Medical condition	1.8	0.7	0.9	0.6	13.6	1.7	1.0	0.4	3.8	1.1	0.8	0.8
Previous caesarian	0.4	0.4	0.5	0.3	0.3	0.2	0.5	0.5	0.3	0.3	0.4	0.3
Precious pregnancy	0.3	0.3	0.2	0.2	0.1	0.1	0.5	0.4	0.5	0.2	0.3	0.2
Other emergency, %	3.7	1.8	4.1	2.8	8.7	1.2	2.3	1.0	0	0	4.2	3.5
Destination hospital, %												
Government	82.0	79.6	82.1	81.7	87.6	96.8	70.2	72.0	96.0	97.6	85.3	84.1
District or tertiary hospital	53.1	19.7	54.2	29.4	64.3	28.5	30.1	7.3	86.8	45.5	55.5	31.7
ESI hospital	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.2	0.2	0.3
Area / Civil hospital	19.8	13.4	18.1	21.1	0.6	0.8	31.5	8.3	7.7	27.3	21.3	22.5
CHC	7.6	34.6	8.3	19.7	20.5	57.4	7.4	43.6	0.9	20.4	6.3	16.2
PHC / UHC	1.1	9.0	1.2	11.3	1.9	9.3	0.2	7.0	0.3	3.2	1.9	13.1
Information Missing	0.4	2.8	0.3	0.0	0.0	0.0	0.9	5.6	0.0	0.0	0.2	0.2
Government supported	3.4	7.7	0.0	0.0	0.0	0.0	16.9	15.9	0.0	0.0	0.0	0.0
Private	14.5	12.8	17.9	18.3	12.4	3.2	12.9	12.1	4.0	2.4	14.7	15.9
Total non-missing	(31,911) 100	(531,392) 100	(12,693) 12.9	(116,028) 100	(1,784) 100	(54,093) 100	(6,442) 100	(256,898) 100	(2,777) 100	(21,449) 100	(8,215) 100	(82,924) 100
Missing	(3082) 8.8	(42,174) 7.4	(1,881) 12.9	(16,772) 12.6	(145) 7.5	(4,788) 8.1	(120) 1.8	(6,611) 2.5	(32) 1.1	(665) 3.0	(904) 9.9	(13,338) 13.9
To different district	32.1	28.5	29.8	28.8	62.5	54.3	17.7	22.0	31.6	10.1	39.7	34.3
To different mandal	86.8	55.9	89.5	75.7	83.2	68.5	74.1	33.0	96.3	93.5	89.5	74.9
Distance call to pick-up site* Km Median (IQR)	2 (1-14)	12 (6-18)	10 (3-18)	12 (6-19)	4 (1-6)	9 (2-17)	1 (1-10)	12 (7-18)	1 (1-1)	11 (6-18)	3 (1-15)	12 (6-20)
Distance pick-up site to hospital,* Km Median (IQR)	28 (18-40)	15 (8-23)	21 (12-31)	17 (10-26)	16 (5-30)	8 (3-15)	24 (14-37)	14 (8-21)	32 (21-48)	12 (6-20)	29 (19-43)	17 (10-28)
Time call to pick-up site,* minutes ; Median (IQR)	11 (7-28)	25 (16-37)	24 (12-37)	27 (17-40)	15 (7-33)	27 (17-39)	10 (7-19)	24 (16-34)	12 (8-27)	35 (22-56)	12 (7-29)	26 (16-39)
Time pick-up site to hosp,* minutes ; Median(IQR)	49 (32-70)	26 (16-40)	37 (23-55)	32 (20-46)	40 (26-64)	21 (13-32)	40 (26-60)	23 (14-34)	83 (57-116)	43 (28-65)	48 (33-70)	31 (20-48)
Time call to hospital,* minutes ; Median (IQR)	77 (56-102)	63 (46-84)	75 (55-97)	72 (54-93)	70 (50-97)	56 (39-77)	64 (47-86)	56 (42-74)	105 (72-143)	80 (54-121)	77 (57-103)	70 (52-93)

Figure 19: Time of the day and day of the week, of calls to '108' for transfer of pregnant women, April 2013 – March 2014



IFT= Inter –facility transfer; Non-IFT= Non- inter-facility transfer

The transfers by '108' were more frequent during 8:00 hours and 14:00 hours, peaking around 12:00 hours with a second smaller peak at around 22:00 hours, in all the states (figure-19). Telangana, Himachal Pradesh and Gujarat had slightly higher proportions of transfers on Mondays, and Chhattisgarh on Thursdays. Across all the states, it was evident that a higher proportion of IFTs compared to non-IFTs were occurring between 10:00 hours to 23:00 hours.

3.8 Determinants of Inter-facility transfer

Overall, women with obstetric emergencies transported by '108' were roughly twice as likely to have an IFT as women with no obstetric emergency (crude OR 2.25, 95% CI 2.16-2.34) (table-27). In the adjusted analysis (excluding Chhattisgarh), obstetric emergencies had 1.95 (95% CI, 1.83–2.06) times higher odds of having IFT compared to non-emergencies (table-27). Women from urban areas were twice as likely to have IFTs as women in rural areas (AOR 2.34, 95% CI 2.26 – 2.40). There was no evidence of an independent effect of high-priority districts on IFT. Overall, there was evidence of a 'J' shaped trend with maternal age. IFTs were marginally more likely in women less than 25, with a trend of increasing odds in women aged 30 or more, compared to women aged 25-30 years (AOR 1.01, 1.04, 1, 1.21, 1.43 respectively for age groups $\leq$19, 20-24, 25-30, 30-34 and $\geq$35 years). Although the effects were small, women from backward castes (AOR 0.95, 95% C.I. 0.92-0.99), scheduled castes (AOR 0.94, 95% C.I. 0.90-0.98), and scheduled tribes (AOR 0.98, 95% C.I. 0.95-1.00) were less likely to have IFT than women from general castes, after adjustment. Women from below-poverty-line (AOR 0.92, 0.88-0.96) were less likely to have IFTs compared to those above-poverty-line.

Table 27: Determinants of IFT across study states (Logistic regression analysis; Odds ratio (95% C.I.))

	Total*	Andhra Pradesh	Chhattisgarh#	Gujarat	Himachal Pradesh	Telangana
Bivariate logistic regression: OR (95% CI)						
Obstetric emergency	2.25 (2.16 – 2.34)	1.81 (1.67 – 1.95)	5.39 (4.76 – 6.09)	2.01 (1.85 – 2.17)	3.15 (2.84 – 3.49)	1.90 (1.73 – 2.09)
Urban area	2.29 (2.23 – 2.34)	1.87 (1.80 – 1.94)	1.09 (0.92 – 1.29)	4.93 (4.69 – 5.20)	6.34 (5.68 – 7.07)	1.68 (1.60 – 1.76)
High priority district	0.96 (0.94 – 0.98)	1.10 (1.06 – 1.14)	1.28 (1.13 – 1.44)	0.69 (0.65 – 0.73)	0.92 (0.83 – 1.01)	0.95 (0.90 – 1.00)
Age group (years)						
≤19	1.06 (1.00 – 1.13)	1.08 (0.98 – 1.18)	1.37 (1.13 – 1.66)	1.28 (1.08 – 1.51)	0.70 (0.57 – 0.86)	1.01 (0.88 – 1.14)
20 – 24	1.03 (1.00 - 1.05)	1.02 (0.98 – 1.07)	1.09 (0.97 – 1.21)	1.10 (1.04 – 1.16)	0.87 (0.79 – 0.95)	1.02 (0.97 – 1.07)
25 – 30	1	1	1	1	1	1
30 – 34	1.24 (1.18 - 1.30)	1.29 (1.17 – 1.42)	1.38 (1.16 – 1.65)	1.25 (1.15 – 1.36)	1.08 (0.93 – 1.25)	1.21 (1.08 – 1.35)
≥35	1.52 (1.41 – 1.64)	1.62 (1.41 – 1.86)	1.68 (1.31 – 2.15)	1.58 (1.39 – 1.80)	1.16 (0.93 – 1.46)	1.47 (1.23 – 1.76)
Social caste						
General caste	1	1	1	1	1	1
Backward caste	0.92 (0.89 – 0.96)	0.95 (0.90 – 1.01)	1.04 (0.68 – 1.58)	0.94 (0.87 – 1.02)	1.55 (1.36 – 1.77)	0.71 (0.65 – 0.77)
Scheduled caste	0.91 (0.87 – 0.94)	1.02 (0.97 – 1.09)	0.91 (0.58 – 1.44)	0.87 (0.79 – 0.96)	0.89 (0.80 – 0.99)	0.67 (0.61 – 0.73)
Scheduled tribe	0.90 (0.87 – 0.94)	1.18 (1.11 – 1.28)	0.83 (0.54 – 1.27)	0.75 (0.69 – 0.81)	1.10 (0.93 – 1.31)	0.71 (0.65 – 0.78)
Below poverty line	0.92 (0.88 – 0.96)	1.45 (1.04 – 2.01)	0.92 (0.22 – 3.80)	0.93 (0.89 – 0.98)	0.83 (0.76 – 0.90)	1.03 (0.75 – 1.41)
Multivariate logistic regression model: AOR (95% CI)**						
Obstetric emergency	1.96 (1.83 – 2.06)	1.80 (1.65 – 1.95)	5.32 (4.70 – 6.02)	1.89 (1.74 – 2.05)	3.03 (2.65 – 3.47)	1.79 (1.61 – 1.98)
Urban area	2.35 (2.26 – 2.41)	1.86 (1.79 – 1.94)	1.09 (0.92 – 1.29)	4.75 (4.50 – 5.01)	5.76 (5.03 – 6.59)	1.64 (1.56 – 1.73)
High priority district	0.98 (0.95 – 1.00)	1.09 (1.05 – 1.13)	1.25 (1.11 – 1.41)	0.90 (0.85 – 0.96)	1.17 (1.03 – 1.33)	1.00 (0.95 – 1.06)
Age group (years)						
≤19	1.01 (0.94 – 1.06)	1.01 (0.92 – 1.11)	1.36 (1.12 – 1.65)	1.25 (1.06 – 1.49)	0.82 (0.65 – 1.05)	0.91 (0.80 – 1.05)
20 – 24	1.04 (0.98 – 1.06)	1.03 (0.99 – 1.08)	1.11 (1.00 – 1.24)	1.12 (1.06 – 1.18)	0.92 (0.82 – 1.03)	1.02 (0.97 – 1.07)
25 – 30	1	1	1	1	1	1
30 – 34	1.21 (1.14 – 1.27)	1.26 (1.14 – 1.39)	1.33 (1.11 – 1.59)	1.21 (1.11 – 1.32)	0.94 (0.77 – 1.14)	1.19 (1.07 – 1.34)
≥35	1.43 (1.35 – 1.56)	1.56 (1.36 – 1.80)	1.52 (1.19 – 1.95)	1.44 (1.27 – 1.64)	0.96 (0.72 – 1.30)	1.43 (1.19 – 1.71)
Social caste						
General caste	1	1	NA#	1	1	1
Backward caste	0.95 (0.92 – 0.99)	0.93 (0.87 – 0.99)	NA#	1.02 (0.94 – 1.10)	1.80 (1.55 – 2.10)	0.79 (0.71 – 0.87)
Scheduled caste	0.94 (0.90 – 0.98)	1.02 (0.95 – 1.08)	NA#	0.99 (0.90 – 1.09)	1.01 (0.90 – 1.14)	0.74 (0.61 – 0.73)
Scheduled tribe	0.98 (0.96 – 1.00)	1.22 (1.13 – 1.31)	NA#	0.94 (0.87 – 1.01)	1.31 (1.08 – 1.61)	0.82 (0.67 – 0.82)
Below poverty line	0.92 (0.88 – 0.96)	1.40 (1.00 – 1.96)	NA#	0.95 (0.90 – 1.00)	0.85 (0.77 – 0.95)	1.34 (0.95 – 1.88)
Pseudo R2	0.076	0.014	0.033	0.054	0.085	0.010

*adjusted for i.state and does not include state of Chhattisgarh; ** Adjusted for obstetric emergency, urban area, high priority district and age group, as appropriate; # for Chhattisgarh social caste and below poverty line were not included

In respect to individual state models, the association between obstetric emergencies and IFT was strongest for Chhattisgarh (AOR 5.32, 95% CI 4.70-6.02) followed by Himachal Pradesh (AOR 3.03, 95% CI 2.65-3.47). The effect for urban women to have IFTs was highest in Himachal Pradesh (AOR 5.76, 95% CI 5.03 – 6.59) and Gujarat (AOR 4.75, 95% CI 4.50 – 5.01). Women from high priority districts had a slightly higher odds of having an IFT in the states of Chhattisgarh (AOR 1.25, 95% C.I. 1.11 – 1.41) and Andhra Pradesh (AOR 1.09, 95% C.I. 1.05 – 1.13), with no observed effect in other states. The 'J' shaped pattern for age was more evident in states of Chhattisgarh and Gujarat while no pattern was observed in Himachal Pradesh. In Telangana women from all three socially disadvantaged castes (AORs between 0.74 and 0.82) and in Andhra Pradesh women from backward caste (AOR 0.93, 95% C.I. 0.87-0.99) were less likely to have IFTs. Conversely, in Himachal Pradesh women from backward castes (AOR 1.80, 95% C.I. 1.55-2.10) and scheduled tribes (AOR 1.31, 95% C.I. 0.77-0.95) and in Andhra Pradesh women from scheduled tribe (AOR 1.22, 95% C.I. 1.13-1.31) were more likely to have IFTs. Women from below the poverty line in Himachal Pradesh (AOR 0.85, 95% C.I. 0.77-0.95) and Gujarat (AOR 0.95, 95% C.I. 0.90-1.00) were less likely to have IFT (table-27).

4 DISCUSSION

The analysis reported here estimated that 17% of pregnant women and 22% of all institutional deliveries in the study populations in 2013-2014 were transported by '108'. This result suggests that '108' was the choice of transport for only one-fifth of pregnant women. Only 4% of all estimated obstetric emergencies and only 1% of all institutional deliveries were transported by '108' as IFTs. The findings suggest that the '108' service is not a preferred choice for transport to a higher-level facility, or for obstetric emergencies. The DLHS-4 survey in 2012-13 found that the proportion of institutional deliveries was

94% in Telangana, 89% in Andhra Pradesh and 78% in Himachal Pradesh.(199-201) Of the institutional deliveries, it was reported that 7% in Telangana, 12% in Andhra Pradesh and 21% in Himachal Pradesh used an ambulance for transport to hospital.(199-201) These figures are broadly in line with the findings reported here.

Although overall utilisation rates were low, we observed pregnant '108' users, including obstetric emergencies, were more likely to be from below the poverty line and scheduled caste and tribes compared to the general population, signifying that relatively more needy women were utilising '108' when pregnant compared to the more well off in most states. Studies have also shown that higher proportions of women who use publicly financed transportation schemes belong to historically disadvantaged and backward social castes, below-the-poverty-line, less educated, and mostly from rural geographical areas compared to non-users.(164, 180, 182, 202)

Calls to '108' were more frequent between 8:00 to 14:00 hours, as also reported by others.(180, 186) A lag of about one hour was observed between peak hours of call for non-IFTs and IFTs. It is plausible that women first reached a facility from home using '108' (non-IFT) and, after initial assessment, some were referred to another facility using the '108' service. The lag time was required to determine the need of referral, provide initial care and arrange notes. A higher proportion of IFTs immediately after 10:00 hours could also be due to the fact that medical officers usually arrive on duty at 9:00 hours to conduct rounds, and would refer the sick cases admitted on the previous night.

The '108' ambulances took longer than the targeted 20 minutes to reach a hospital for more than 60% to 80% pregnant women in the study states. The women with obstetric emergencies travelled larger distances and in longer time compared to women without

emergencies. This was probably due to the fact that the emergency had to be transported across longer distances from rural towns to district headquarters.

The median time from call to '108' and reaching the destination facility was similar for non-IFT, and IFT, and it ranged from 1 hour to 1.3 hour. A study of 57 maternal death reviews from Uttar Pradesh found much longer times; the mean time taken to arrange transport and travel from home to facility was about 4 hours, and transport from one facility to another was about 10 hours.(37) Although the '108' service has a mandate to inform the destination facility before arrival to reduce delays in treatment, this is not practiced as the list of contact points is not provided to EMTs.[Source: Dr. GVR Rao]

In this study, between 1.3% and 4.8% of the pregnant women delivered at the pick-up site or en-route in the ambulance. A systematic review about birth before arrival found that 0.1% to 2.0% of births happened en-route or outside the hospital.(203) Of these, 28% to 91% were attended by paramedics, however these births were reported to have higher proportion of maternal and neonatal complications after intervention compared to hospital births. Thus paramedics need to be adequately trained for basic emergency obstetric and newborn care.(203) EMTs in '108' ambulances are trained to handle emergency childbirth and complications with telephonic advisory support from a call centre based medical officer.(Source: Expert from GVK-EMRI) However, outcomes of deliveries assisted by these trained EMTs need to be further studied.

4.1 Role of '108' for obstetric emergencies and inter-facility transfers

A previous study estimated that GVK EMRI '108' ambulance services contributed to a 15% reduction in the MMR in 2009 in (undivided) Andhra Pradesh by facilitating the proportion of institutional deliveries and probable lives saved.(185) However, the analysis was a crude estimation without accounting for the proportion of obstetric emergencies

transported, and other social, economic and health system factors. Another study conducted in the state of Punjab in 2013, observed that there was sudden increase in institutional deliveries immediately after initiation of '108' ambulance service, but the adjusted analysis suggested that '108' did not significantly contribute to this increase in institutional delivery.(186)

While the transport services may transport all pregnant women, irrespective of high-risk or actual complication, the success of such a system should be measured by the proportion of all pregnant women with complications who were transported to an appropriate level of care. In our study, the estimated proportion of obstetric emergencies in the population transported by '108' was 12.7% in Himachal Pradesh, 7.2% in Gujarat and less than 3.5% in other states. It is thus unlikely that '108' ambulances had significant impact on maternal death due to complications in pregnancy.

However, it is known that most complications arise during or after delivery.(204) While most of the pregnant women were transported by '108' during normal labour pains, it is likely that some would have developed complications after reaching the hospital. It is also possible that women with emergency preferred to use their own vehicle or other faster means of transport than waiting for '108'. A study conducted in 3 districts of (undivided) Andhra Pradesh in 2009 showed that 43.5% of patients (including pregnant women) admitted to casualty departments used '108' ambulances, and 56% of the '108' users resided within 20 kilometres of the hospital. Only 10% of the non-users called '108' but an ambulance was not available for them. Among the non-users of '108', 67% hired a private taxi/auto, 20% used their own vehicle, 7% used other private ambulances and the remaining used other modes of transport.(182)

The proportion of IFTs among all institutional deliveries depend on the pattern of use of level of health care, referral practices and the availability of transport for between facility transfers. We observed that roughly one-half of the non-IFTs went to peripheral birthing centres or basic EmOC centres. A systematic review from India (including most studies from public health facilities) found that between 14% and 36% of all pregnancies were referred from nurse-run delivery or basic EmOC centres, and a further 2% to 7% were referred from doctor- run basic EmOC centres for complications or emergencies.(151) Assuming the pattern of use of health facilities in our study and evidence from this review, we estimate that between 40,000 and 80,000 institutional deliveries who used '108' for non-IFTs may require further referral to higher facility. In addition, among the estimated 80% (2,300,000) institutional deliveries who went to their first facility by other means of transport, some women may be referred further. Thus the absolute numbers of pregnant women referred and requiring transport for IFT are likely to be large , but '108' transported only about 35,000 pregnant women for IFT in these states.

In our analysis, of all the transfers by '108' only 5.8% were between facilities—lowest 2.4% in Gujarat and highest 11.3% in Himachal Pradesh. The proportion of IFT was higher in states of Karnataka and Tamil Nadu (12.8% and 35.7%) among '108' users in 2013-14.(162) Tamil Nadu has dedicated It appears that there is potential for increasing use of '108' for IFTs in the study states.

A study conducted in Andhra Pradesh in 2009, found that none of the pregnant women who used '108',were referred from a facility.(182) Some women did not prefer to wait for '108' if they perceived any emergency.(182) A maternal death review in Uttar Pradesh in 2010 found that only 5 of the 32 mothers who were transferred between

facilities used an ambulance.(37) However, for other public transportation schemes, it was found that a high proportion (two-thirds) of all the inter-facility referrals in a study from Madhya Pradesh used *Janani Express Yojana* (non-ambulance) while others used personal transport, taxis, autorikshaws or public transport.(78)

Although IFTs in our study were twice as likely to transport pregnant women who had any obstetric emergency compared to non-IFTs, there was a very large proportion of IFTs with no emergency or complication (92%). One of the '108' doctors, during discussion to understand IFT processes, mentioned that on many occasions they were not convinced of the need for IFT. However, on insistence of the referring staff, the '108' doctor approved transport for IFT (personal communication). Often the referral was done because there was no doctor on duty or other resources were not available, as was also found in Madhya Pradesh.(78)

4.2 Future role of '108'

India has achieved targeted institutional delivery rates. Now the debate concerns the future role of '108' in transporting normal labour cases compared to obstetric emergencies and IFTs, as well as strategies to increase the impact on maternal and perinatal mortality for less cost. An important question is- Are '108' type ambulances, which are sophisticated vehicles, required to transport women in normal labour? Studies in Nigeria and India suggest that improving transport to EmOCs does not necessarily require ambulances.(193, 195) Studying the morbidity patterns during transport and after admission, and outcomes of pregnancy among users and non-users of '108', will help assess the effectiveness of transport for normal labour or obstetric emergencies. Telangana and Andhra Pradesh are piloting an intervention to call the potential users of '108' in the last month of pregnancy to plan the transport and place of delivery

beforehand. They foresee that this relationship will increase the use of '108' services and also help in planning ahead for the pregnant women with high-risk or early complication in pregnancy.(Source: Expert from GVK-EMRI). Evaluation of this pilot may provide insight into the acceptance of '108' services, preferences, cost and, potential and necessity of increasing the usage of '108'.

A second important question is what should be done when the number of users of '108' reach a plateau over time, as is evident in states of Telangana and Andhra Pradesh after 10 years (Source: annual records from GVK-EMRI). Does India require interventions to further increase the use of '108' ambulances for all, and to what extent? Will that be cost-effective? Or does India require to rationalise the use of '108' by offering free services for the poor and some fee for others? The *Janani Express Yojana* model in Madhya Pradesh utilises local private taxi operators to transport pregnant women on subsidised rates although without any supportive medical treatment. These are very successful in remote places. *Janani Express Yojana* model is combined with centrally managed '108' ambulance services in state of Madhya Pradesh to increase the reach to the wider population.(165)

The next concern is about use of '108' services for IFTs. IFTs are usually for large distances and for longer times. An IFT will occupy a '108' ambulance for a long duration and it will not be available for other emergencies in its region during that period. Haryana *Swasthya Vahan Sewa* and '102' ambulance systems utilise the existing ambulances at the government health institutions for IFTs, drop back to homes, and other elective pregnancy transports. In the state of Assam, the '108' service manages general emergencies and the '102' service provides IFTs. However, the efficiency and population utilisation rates for obstetric emergencies in these models is not yet assessed.

Having GPRS enabled ambulances and mapping the pick-up and destination points can help monitor the geographic reach of the ambulances, health system utilization, and planning for better coverage, and reduced travel distances and times.

4.3 Strengths and limitations

This is a unique analysis where the proportion of all women in the population transported by '108' was computed—for pregnancy, pregnancies with obstetric emergencies, and for institutional deliveries. We studied the social, economic and geographical distribution of '108' users, which helped in assessing the coverage by '108' at the population level. The analysis also had an advantage that the key national surveys for the country (SRS, DLHS-4, AHS) for maternal health were conducted during the study period, thus we could triangulate datasets to drive population based interpretations. We also estimated the proportion of institutional deliveries in the population that were transported between facilities by '108', and compared IFTs and non-IFT transfers by '108', which helped identify areas of improvement for IFTs.

A main limitation of this study is that details on the type of obstetric emergency were based on the clients claim, the doctor's report (in case of IFT), or diagnoses made by the EMT, however, we could not get information on the distribution of these. Thus the skill for diagnosis made for emergencies was not uniform and may be inaccurate. This may affect the validity of the reporting. It cannot be estimated if this would have led to over-estimation or under-estimation of the proportion of obstetric emergencies. Details on the type of emergency were not available for clients who were not assigned an ambulance and for most of the clients who did not use an ambulance despite being assigned one. Thus the proportion of obstetric emergencies for these two groups could not be computed. The assumption used for estimating population proportions of obstetric

emergencies—that at least 15% of all pregnancies are likely to develop complications that may require higher level of care—is debatable and may not be accurate for the study areas. Some women would have used '108' service more than once and be counted more times for the same incidence. There was no mechanism to identify these in the database. We assume that these will be a very small proportion and are unlikely to affect the overall results.

Data for treatment given en-route, and doctors' notes on IFTs were mostly not recorded in the '108' database. Thus this aspect of the ambulance service could not be studied. Details of the source hospital for IFTs were not available and thus details of transfers between type of facilities could not be assessed. There is a possibility that a proportion of calls for IFT for the women residing in rural areas were wrongly recorded since they called from the health facilities in urban areas to request an IFT. This would have contributed to a higher proportion of urban women among IFTs. The '108' service from Chhattisgarh was taken over by the '102' service since October 2013 thus use of '108' may be under-estimated for this state.

In Assam, the '102' service provided IFTs, and we did not have access to this data. Thus we could not analyse proportions and determinants of IFT in Assam. We had large proportions of missing information on social and economic status from two states. We considered that the missingness was not at random and was not associated with outcome. There is evidence that in such situations a complete case analysis, as we reported, is associated with negligible bias compared to a multiple imputation approach.(198)

4.4 Conclusion

The '108' ambulances were used by less than one-fifth of women in 6 Indian states estimated to be pregnant over the period 2013-14. Use was more prevalent among the

poor, and lower social and economic sections of the population. Although '108' is assumed to play a pivotal role in providing pre-hospital stabilising care in obstetric emergencies, only a small proportion of journeys made by pregnant women were for complications or emergency in pregnancy.

Of all the estimated institutional deliveries in India, only a very small proportion made use of the '108' ambulance for transfer between facilities. Among '108' users for IFTs around 92% did not have any complication or emergency. After adjusting for confounding factors, IFTs were more likely for women with obstetric emergencies, more than 30 years of age and from urban areas. Pregnant women from socially disadvantaged castes, below poverty line and from high priority districts were less likely to have IFTs.

Utilisation of the '108' service and its determinants varied across states. Primary research is required to understand variation in utilisation and to explore the potential of the '108' ambulance service to serve a higher proportion of women with obstetric emergency and those requiring IFTs. The '108' service would benefit by having a triage system to ensure that women with an obstetric emergency requiring an IFT are prioritised. There is a possibility of integrating '108' services with other publicly financed transport intervention models in India. Effectiveness of combination services existing in few states should also be assessed.

Although there is a large proportion of pregnant women who do not use '108', it is probable that they prefer other modes of transport. Further community-based studies are required to study the knowledge, and preferences of pregnant women in different sections of society and to assess the potential for increasing or rationalising the use of '108' services.

CHAPTER 9: OUTCOMES FOR PREGNANT WOMEN WHO REQUESTED A '108' AMBULANCE IN INDIA: A TELEPHONE SURVEY

Submitted: Singh S, Doyle P, Campbell OMR, Rao GVR, Murthy GVS. Outcomes for pregnant women who requested a '108' ambulance in India: a telephone survey. *BMJ Global Health*. (Paper-4 submitted)

London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
www.lshtm.ac.uk

Registry
T: +44(0)20 7299 4646
F: +44(0)20 7299 4656
E: registry@lshtm.ac.uk

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	SAMIKSHA SINGH
Principal Supervisor	PAT DOYLE
Thesis Title	REFERRAL SYSTEMS AND TRANSPORT FOR EMERGENCY OBSTETRIC CARE IN INDIA

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?			
When was the work published?			
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
Have you retained the copyright for the work?*	Choose an item.	Was the work subject to academic peer review?	Yes

**If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.*

SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	BMJ Global Health
Please list the paper's authors in the intended authorship order:	Singh S, Doyle P, Campbell OMR, Rao GVR, Murthy GVS
Stage of publication	**Submitted**

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I planned and conducted the research, and wrote the manuscript.

Student Signature: _____ **Date:** 19 September 2017

Supervisor Signature: _____ **Date:** 19 September 2017

1 INTRODUCTION

The research described in Chapter 8 showed that the '108' ambulance service was used by only one-fifth of pregnant women in the populations studied, and only a small proportion of journeys were for obstetric emergencies and/or IFTs.(151, 205) There is a need to understand the factors which lead women and their families to call the '108' ambulance service, and to use it when it arrives. Women's own perceptions of high-risk conditions, complications, and emergencies in pregnancy, and the ready availability of other means of transport, may contribute to the decision to call for a '108' ambulance.(164). Also, some women may deliver before the arrival of an ambulance after making a call (Chapter 8).(151)

The call centre data do not capture information on high-risk conditions in pregnancy, complications in early pregnancy, or the outcome of pregnancy following ambulance journeys. The analyses described in Chapter 8 were thus unable to examine the frequency these in pregnant women who called '108'. In addition, the analyses in Chapter 8 did not allow analyses of women and utilisation patterns for health care among who called for a '108' ambulance but did not use it.

There is little evidence in the literature around decisions to use transport interventions with respect to high-risk conditions, early complications and emergencies in pregnancy, or outcomes of pregnancy following transport. This telephone survey was set up to describe the characteristics and outcomes of pregnant women, and the type of health facility used by them, who requested a '108' ambulance in two Indian states. We compared information for women who were transported by '108', and those who called '108' but were not transported.

1.1 Objectives

Using the '108' ambulance service platform in two states, Andhra Pradesh and Himachal Pradesh, we aimed:

i. To study the socio-demographic, geographic and self-reported clinical characteristics of pregnant or postpartum women who contacted the service,
ii. To study the type of health facilities used with respect to high-risk in pregnancy, early complication in pregnancy or obstetric emergency and type of referral, and
iii. To study the outcomes of pregnancy in those who contacted the service.

2 METHODS

2.1 Study design

Cross-sectional telephone surveys were conducted in Andhra Pradesh and Himachal Pradesh to obtain information on women who called '108' ambulance and used it, and those who called but did not use the service. The state of Andhra Pradesh divided subsequent to the survey (into (new) Andhra Pradesh and Telangana), but in this paper it refers to the undivided Andhra Pradesh state. Andhra Pradesh is in the south of India and Himachal Pradesh in the north. Andhra Pradesh is mostly plain terrain and has better than average maternal health indicators for India. Himachal Pradesh is hilly and has poor maternal health indicators. Studying the two states provided different perspectives with respect to geographic terrain and quality of health service delivery.

The interviews were conducted by a research assistant under my direct supervision. Ethics approval for the study was obtained from Indian Institute of Public Health-Hyderabad and London School of Hygiene and Tropical Medicine. (LSHTM Ethics Ref: 9613; IIPHH Ethics Ref: IIPHH/TRC/IEC/009/2014)

2.2 Study population

The study populations for each telephone survey were made up of three groups of pregnant women, those i) who called '108' and were transported using '108' ambulance, ii) who called '108' and were sent an ambulance, but did not use it , and iii) who called '108' but were not assigned an ambulance.

2.3 Sample size

Sample sizes were estimated based on preliminary findings from an analysis of existing '108' data for two months, for the two states. For those who were transported using a '108' ambulance in Andhra Pradesh (n=49,672) and Himachal Pradesh (n=6,496), it was estimated that 600 women from each state would provide the study with 80% power to detect a 10% prevalence of obstetric complications with an absolute precision of 2.5%. Data on the proportion of complications for those who did not use an ambulance, and who were not assigned an ambulance, was not available from this preliminary analysis. Over the two month period 2,342 pregnant women in Andhra Pradesh, and 2 in Himachal Pradesh, did not use the assigned ambulance. The numbers not assigned an ambulance were 1,615 and 72 respectively in Andhra Pradesh and Himachal Pradesh. This being the case, in Himachal Pradesh we sampled all women who did not use an ambulance, and all women who were not assigned an ambulance. In Andhra Pradesh we sampled 1 in 10, aiming to obtain 250 women who did not use an ambulance, and 150 women who were not assigned an ambulance.

2.4 Sampling and data collection

Data were collected for three months from each state. We recruited and interviewed participants in the first two months and tracked them for newborn and maternal outcomes in the following month. Each call to '108' is routinely recorded on the call-centre

database, and coded into one of the three transport groups. The lists from all three groups for the previous 24 hours were obtained on a daily basis for around two months. Systematic random sampling was done to recruit women from lists obtained daily. In Andhra Pradesh, each day for 50 days we sampled a total 12 (600/50) of those who were transported using an ambulance, five (250/50) who did not use an ambulance and three (150/50) who were not assigned an ambulance. In Himachal Pradesh per day, 12 women who were transported using an ambulance were likewise sampled but for other two groups we included all the women from the lists. Days of data collection were systematically selected in a manner that each day of the week was represented and the researcher worked accordingly. Caller (who called '108') phone numbers were tried up to five times in a span of two hours. If there was no response, a replacement woman who was next in serial order with time of call was selected. If the number belonged to an unrelated caller who could not provide any information, then another woman next in serial order was chosen. Calls were made until the required number of completed interviews per day were conducted or until the end of the working day. A log of all the calls was maintained, with reason for exclusion. Follow-up calls were made at 48 hrs, 7 days and 28 days after the initial call to '108'.

As this was a telephone survey, written consent could not be obtained. Thus verbal consent was taken before conducting the interviews. We asked the reason for non-participation from those who did not give consent. Interviews were conducted from 10 am to 6 pm by telephone using a pre-tested questionnaire in the local language (Annex-IX). The questionnaire was designed to gather information on the following variables: Socio-demographic information; region; district; reason for calling '108'; who referred (self or health worker); high-risk or obstetric complications; place of delivery; waiting and

travel times; distances; problems faced and health status of mother and/or child. Follow-up interviews with clients collected information on the outcome of pregnancy, and the health status of newborn and the mother.

2.5 Working definitions

A 'high-risk pregnancy' is defined as a pregnancy with a demographic characteristic, obstetric history, or medical history that suggests an elevated risk of developing a complication.(206) An 'early complication in pregnancy' is defined as a medical complication that developed as a consequence of pregnancy or a medical condition complicated by pregnancy.(207) Any complication in pregnancy or during labour or childbirth, or after (within 42 days of termination of pregnancy) that is life threatening to the mother or foetus, is defined as an obstetric emergency. (Refer Annex 1, table 34)

It was difficult to assess if the complication present at the time of call to '108' was indeed life threatening. For this study, any complication in pregnancy reported as present at the time of the call to '108', and for which the call was made, was defined as an 'obstetric emergency'. Secondly, if the user perceived and reported an emergency at the time of call, this was accepted as an obstetric emergency from the users' perspective.

A list of common conditions classified under these categories was prepared based on guidelines for SBAs in India.(14) The reported conditions are listed in the tables presented in the Annex-Xa.

2.6 Analysis

Data were recorded in Ms-Access and transferred to Ms-Excel. Data were inspected before use to assess consistency, range, and missing data. Where appropriate, data were recoded. Analysis was done using Stata version 13.0. Summary tables for each state were prepared in order to examine the variables of interest. Cumulative proportions were

computed for pregnancy outcomes and mortality in the period between call made and follow up. Results were described separately for each of the study '108' transport groups, separately by state. Chi-square tests of significance for the difference between proportions was applied to compare key variables in the three study '108' transport groups.

3 RESULTS

In Andhra Pradesh, 582 women who were transported using '108' ambulances, 215 who were sent an ambulance but did not use it, and 74 who were not assigned an ambulance were included in the study. From Himachal Pradesh, 615 women who were transported using '108' and 111 women who were not assigned an ambulance were included in the study. Only nine women in Himachal Pradesh did not use an ambulance and these were not included in the analysis. Interviews were conducted with the pregnant women or her husband/relative/friend, who called '108' for an ambulance.

3.1 Response to the calls made (table-28)

In both the states, more calls than expected had to be made to get the desired number of completed interviews. Table-28 describes all the calls made and reasons for exclusion. In Andhra Pradesh, of the total calls, 12% of the women were transported back to home (reverse transport) after treatment and these were not eligible for inclusion. A considerable proportion of callers in Andhra Pradesh (between 11% and 16% in the groups) could not provide information about the pregnant women. Most of these were health staff, notably doctors and nurses. Calls by community health workers (ASHAs or ANMs), who could provide information about the pregnant women or provide phone numbers for the relatives of pregnant women, were included. Several phone numbers of

the callers were not reachable even after 5 times of calling over 2 hours. In Andhra Pradesh, a higher proportion of callers who were not assigned an ambulance (27%) and who did not use the ambulance (22%) were not reachable compared to those who were transported using '108' (17%). It is likely that some of the non-reachable callers were in hard to reach zones or were wrong numbers. Of the total calls in Himachal Pradesh, 11% callers could not provide information and 13% were not reachable. There were no large differences in these proportions between the groups in the study states (p>0.05).

Table 28: Response to calls made to pregnant women/relatives/others who called '108' service (telephone survey)

	Total calls made N (%)	Caller not reachable N (% of total)	Unable to provide information N (% of total)	Reverse transport N (% of total)	Eligible N (% of total)	Consent not given n (% of eligible)	Complete interview n (% of eligible)
Andhra Pradesh							
Transported using ambulance	1207 (100)	208 (17.2)	185 (15.3)	146 (12.1)	668 (55.3)	86 (12.9)	582 (87.1)
Ambulance assigned but not used	570 (100)	126 (22.1)	91 (16.0)	80 (14.0)	273 (47.9)	58 (21.2)	215 (78.8)
Ambulance not assigned	186 (100)	50 (26.9)	21 (11.3)	17 (9.1)	98 (52.7)	24 (24.5)	74 (75.5)
Total	1963 (100)	384 (19.6)	297 (15.1)	243 (12.4)	1026 (52.3)	168 (16.4)	858 (83.6)
Himachal Pradesh							
Transported using ambulance	899 (100)	119 (13.2)	98 (10.9)	0	682 (75.9)	67 (9.8)	615 (90.2)
Ambulance not assigned	170 (100)	23 (13.5)	21 (12.4)	0	126 (74.1)	15 (11.9)	111 (88.1)
Total	1069 (100)	142 (13.3)	119 (11.1)	0	808 (75.6)	82 (10.1)	726 (89.9)

Caller not reachable = Phone number was not reachable or was unanswered even after calling five times over a span of two hours. Unable to provide information = Caller who could not provide information about the pregnant women were not included. Reverse transport = Mother and child were transported back from hospital to home and were not eligible. Consent not given caller refused to participate in the survey.

In Andhra Pradesh 1,026 callers were eligible, of whom 858 callers (84%) consented and were interviewed. The response rate was higher among the women who were transported using '108' (87%) compared to those sent an ambulance but who did not use it (79%), or who were not assigned an ambulance (76%). In Himachal Pradesh, 808 were eligible, of whom 726 (90%) consented and were interviewed. The callers who did not provide consent were either busy or were upset with not being provided a '108' ambulance.

3.2 Social, demographic and geographic characteristics (Annex-Xa)

More than 90% of women included in the survey were between 20 and 34 years of age in both states. The majority of pregnant women were Hindu's and from rural areas. In Andhra Pradesh, those who accessed '108' services were mostly from socially disadvantaged castes, while in Himachal Pradesh those who accessed '108' were mostly from general castes. In Andhra Pradesh, nearly all (90%) women belonged to below-the-poverty-line strata while in Himachal Pradesh these made up only 16% of the interviewees. About two-fifths of the pregnant women and their husbands were illiterate in Andhra Pradesh compared to only 5% in Himachal Pradesh.

There were no large differences in socio-demographic characteristics between the study groups within each of the states. One exception was in Himachal Pradesh, where a higher proportion of women who were not assigned an ambulance were from tribal areas (23%) compared to those transported using '108' (4%) ($p<0.001$).

3.3 Details of calls made to the '108' service

The vast majority women in Andhra Pradesh (90%) and Himachal Pradesh (96%) called because of normal labour pains. More than 80% of the callers were self-referred, with

calls largely made by a husband or other immediate family member in both the states (table-29). Most referrals by health staff from Andhra Pradesh and Himachal Pradesh were from village level ASHAs/AWWs.

In Andhra Pradesh, 15.2% of the women who were transported were referred by health staff. This proportion was lower (11%) among women who did not use an ambulance but higher (21%) in women who were not assigned an ambulance. In Himachal Pradesh, women who were transported using '108' were three times more likely to be referred by health staff (15%) than those not assigned an ambulance (5%) (p=0.003).

Table 29: Details of the calls made to '108' for pregnant women included in the telephone survey

	Andhra Pradesh			Himachal Pradesh	
Use of ambulance	Transported using ambulance N= 582, %	Ambulance assigned but not used N= 215, %	Ambulance not assigned N= 74, %	Transported using ambulance N= 615, %	Ambulance not assigned N= 111, %
Relationship of the caller with the pregnant women					
Husband	40.0	34.4	36.5	47.2	37.8
Parents/ Parents in-law	19.5	17.7	19.0	16.3	19.8
Siblings/ Siblings in-law	21.6	26.5	21.7	16.5	19.8
Other relative/ friend	6.7	10.7	8.1	8.5	14.4
ASHA/ ANM/Nurse/Doctor	14.8	10.2	13.5	11.2	8.1
Others	0.3	0.5	1.4	0.5	0.0
Person who suggested to call '108' for ambulance					
Self/relatives	84.3	88.4	76.7	84.8	94.6
Referred	15.2	10.6	20.6	15.1	5.4
Referred by ASHA/AWW	*10.5*	*6.5*	*15.1*	*15.1*	*5.4*
Referred by ANM/Nurse/Doctor	*4.7*	*4.2*	*5.5*	*0.0*	*0.0*
Others	0.8	0.9	2.7	0.2	0.0
Reason for calling '108'					
Routine Antenatal checkup	2.6	1.9	0.0	0.0	0.0
Antenatal with complication	4.2	2.3	0.0	0.2	0.0
Labour pains	89.8	88.4	95.9	90.7	94.6
Labour with complication	3.2	4.7	2.7	9.1	5.4
Post-delivery with complication	0.0	2.8	1.4	0.0	0.0
Routine post-delivery checkup	0.3	0.0	0.0	0.0	0.0
Obstetric emergency at the time of call to '108'*	7.4	9.8	4.1	9.3	5.4

* Sum of complications in antenatal, in labour and post-delivery

3.4 High-risk and early complication in pregnancy, and obstetric emergency

We enquired about demographic and obstetric high-risk, and complications at any time in the current pregnancy (table-30). In Andhra Pradesh, a high-risk pregnancy was reported by 22% women who were transported compared to 17.7% of those who did not use an ambulance, and 19% those not assigned an ambulance (p=0.350). In Himachal Pradesh, 27% of women who were transported compared to 19% of women who were not assigned an ambulance had a high-risk condition in pregnancy (p=0.073). In Andhra Pradesh, an early complication in pregnancy was reported twice as frequently by the women who were transported (16%) compared to other two groups (8% each) (p=0.006). In Himachal Pradesh, an early complication in pregnancy was reported by around 15% women in both the groups. In Andhra Pradesh, an obstetric emergency was reported by 7% women who were transported by a '108' ambulance, 9% of the women who did not use the ambulance and 4% who were not assigned an ambulance (p=0.252). In contrast, a higher proportion of women in Himachal Pradesh who were transported reported an obstetric emergency (9%) compared to the other group (5%), although this difference was not statistically significant (p=0.183).

Overall, in both the states, the proportion of women who had a high-risk in pregnancy, early complication in pregnancy, or obstetric emergency (combined) at the time of call, was higher among women who were transported (36% in Andhra Pradesh and 41% in Himachal Pradesh) compared to who did not use an ambulance (30% in Andhra Pradesh), and those not assigned an ambulance (24% in Andhra Pradesh and 35% in Himachal Pradesh) (table-30). The evidence for differences in these proportions was stronger in Andhra Pradesh (p=0.050) and weak in Himachal Pradesh (p=0.248).

The types of high-risk, early complication and obstetric emergency that were reported are described in Annex-Xb. Most common high-risks reported were previous caesarean section, age less than 20 years, and short stature. Women from Andhra Pradesh also reported higher proportions of multigravida and history of neonatal death. In the current pregnancies about one-tenth of women reported severe anaemia, and 2% had high blood pressure. Commonest emergencies in pregnancy were bleeding, high fever and ectopic pregnancy. Most common obstetric emergencies reported at time of delivery were preterm labour, moderate to severe anaemia, excessive bleeding and high blood pressure.

3.5 Destination hospital

Table-30 describes pattern of use of health facilities by those who called '108'. In Andhra Pradesh, 44% of women who did not use an ambulance, and 12% who were not assigned an ambulance, were not transferred to any health facility. Most of these women delivered or stabilised before any transport was used.

In Andhra Pradesh among the women who were transported using '108', almost half went to government Sub-district/ District hospitals and one-quarter to PHCs and CHCs. Amongst the women who were transported by means other than '108', use of government facilities was low and a higher proportion went to private hospitals compared to those transported by '108' ambulance ($p<0.001$). In Himachal Pradesh, more than 90% were transferred to government Sub-district/ District hospitals across both the groups ($p=0.009$). But use of PHCs and CHCs was less likely in Himachal Pradesh compared to Andhra Pradesh (table-30).

Among the women who were transferred by other transport, 90% hired an auto-rikshaw or a taxi in both states and only six women in Andhra Pradesh used another form of ambulance.

3.6 Outcomes of pregnancy

Table-30 and Figures 20 to 22 describe the mode of delivery, outcome of pregnancy, place of outcome and follow up for all the study groups. For the description of results in this section and the next, the group of women in Andhra Pradesh who did not use a '108' ambulance despite of being sent one, and those who were not assigned an ambulance, were combined to form a group not transported by '108', while in Himachal Pradesh this was only the group not assigned an ambulance.

Between 5% and 7% women in Andhra Pradesh, and 8% and 10% in Himachal Pradesh, did not deliver within 28 days following the call to '108' (table-30). No women in Andhra Pradesh and only four women in Himachal Pradesh had abortions (type not known). Of the women who delivered in Andhra Pradesh, 1% transported by '108' and 30% not transported by '108' delivered at home (data not shown). In Himachal Pradesh these proportions were 6% and 1% respectively. In Andhra Pradesh, a high proportion of women delivered by caesarean section- 23% of those transported by '108' and 15% of those not transported by '108' (p=0.015). In Himachal Pradesh caesarean section rates were lower than Andhra Pradesh-13% among those transported by '108' and 14% of those not transported by '108' (p=0.842).

Table 30: Obstetric details and outcomes among pregnant women who called '108'

	Andhra Pradesh			Himachal Pradesh	
Use of ambulance	Transported using ambulance N= 582, %	Ambulance assigned but not used N= 215, %	Ambulance not assigned N= 74, %	Transported using ambulance N= 615, %	Ambulance not assigned N= 111, %
High-risk in current pregnancy	22.2	17.7	18.9	27.0	18.9
Early complication in current pregnancy	16.2	8.4	8.1	15.9	16.0
Obstetric emergency at time of call to '108'	7.4	9.8	4.1	9.3	5.4
Any high-risk/ complication/ emergency	36.4	30.2	24.3	41.0	35.1
Not transported to any hospital (delivered at home or stabilised)	0.0	43.7	12.2	0.0	0.9
Type of Hospital pregnant woman was taken to (% of transported)					
Primary Health Centre	26.5	29.8	24.6	3.1	0.9
Community Health Centre	15.8	10.7	20.0	10.7	3.6
Sub-district / District hospital	45.5	28.1	40.0	85.2	92.7
Private clinic / hospital	12.2	31.4	15.4	1.0	2.7
Mode of delivery					
Did not deliver within period of follow up	7.0	6.0	2.7	8.3	9.9
Abortion	0.0	0.0	0	0.7	0
Delivered	92.3	93.9	97.3	88.3	90.1
Lost to follow up	0.5	0.1	0.0	2.8	0
Caesarean rate (% of all delivered)	23.1	13.8	19.4	13.3	14.0
Death of the pregnant women during transfer or within 28 days of transfer	0.0	0.8	0.0	0.0	0.0
Intra-uterine death/ Still-birth (% of all delivered)	1.7	0.5	0.0	2.8	2.0
Neonatal deaths (% of all live births)	2.7	3.0	2.8	2.1	5.1

Figure 20: Follow up of pregnant women who were transported using '108' ambulance with their outcomes in state of Andhra Pradesh

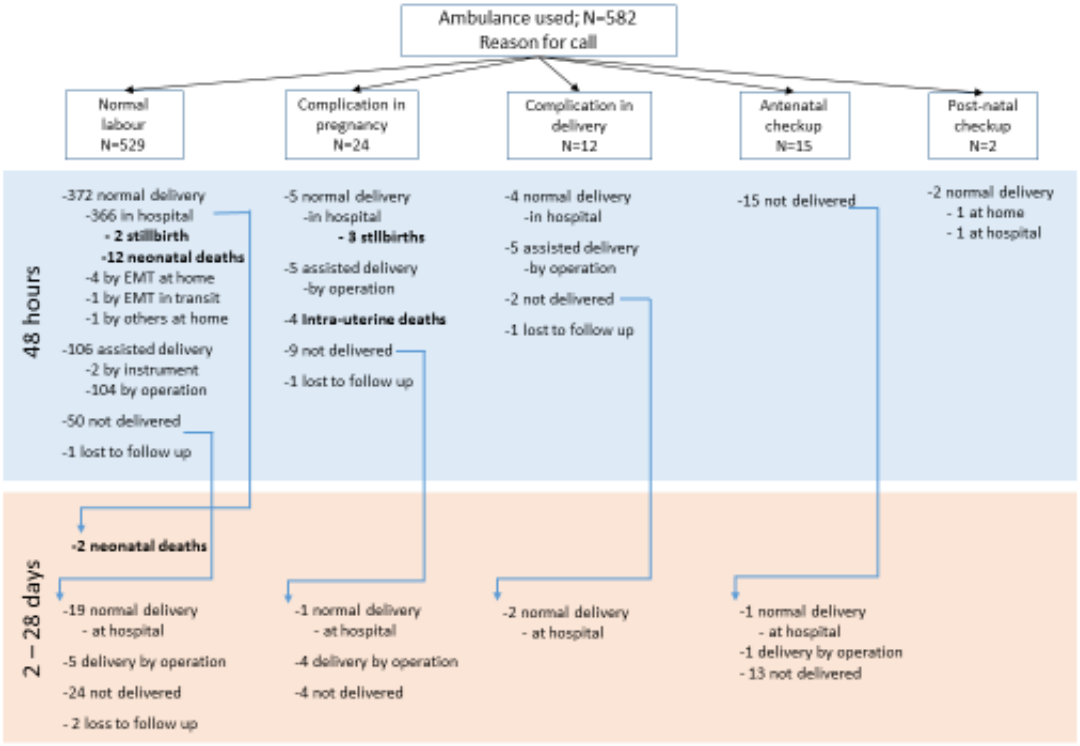


Figure 21: Follow up of pregnant women who were not transported by '108' ambulance with their outcomes in state of Andhra Pradesh

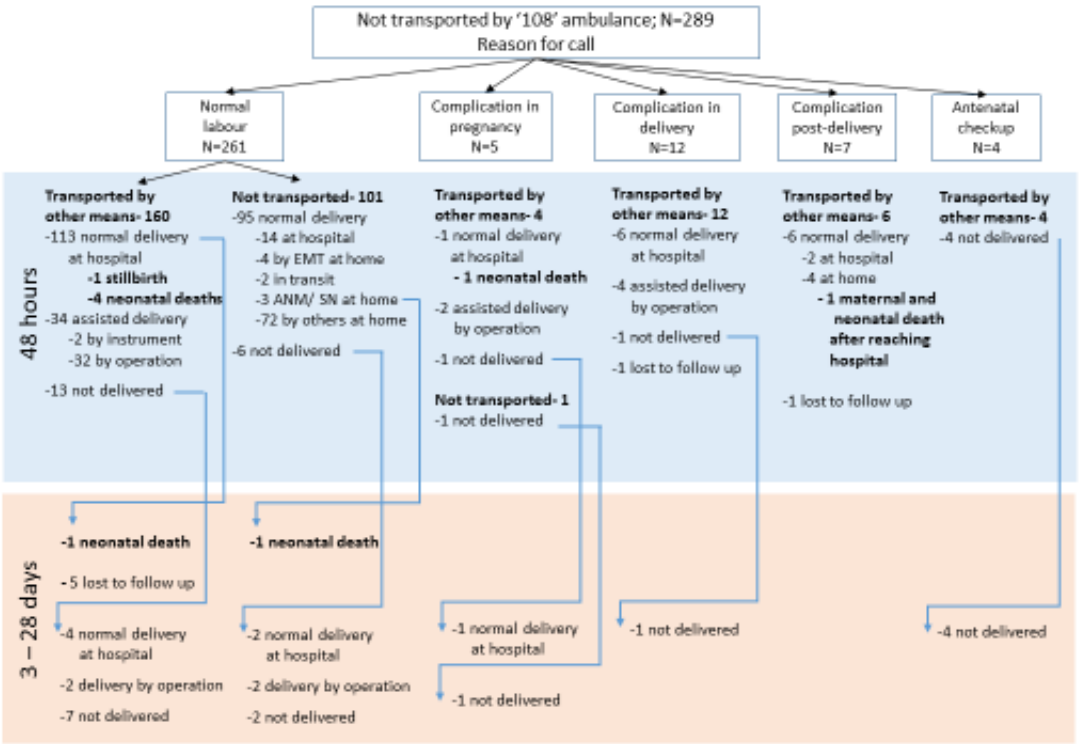
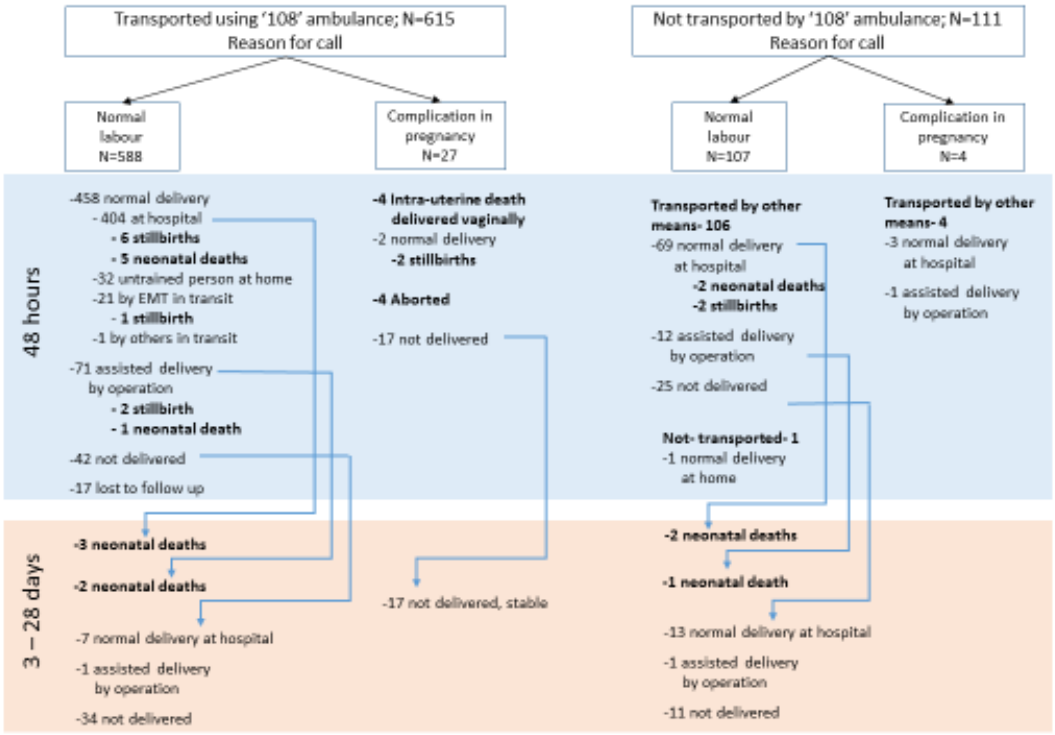


Figure 22: Follow up of pregnant women who were transported using '108' ambulance and who were not transported by '108' ambulance with their outcomes in state of Himachal Pradesh



Only one pregnant women, who was not transported by '108', died in Andhra Pradesh, and none in Himachal Pradesh. Ten stillbirths and 22 neonatal deaths were reported in Andhra Pradesh, and 17 and 16, respectively, in Himachal Pradesh. The proportions of neonatal deaths were similar across the transport groups in Andhra Pradesh (between 2.7% and 3.0% of all live births) but in Himachal Pradesh neonatal deaths were more than twice as common in women not transported by '108' (5.1% of all live births) compared to those transported by '108' (2.1% of all live births) (table-30). However there were no statistical differences in the proportions of stillbirth and neonatal deaths between transported and non-transported women in either of the two states ($p>0.05$).

3.7 Utilisation of type of hospitals by type of obstetric complication and type of referral

In Andhra Pradesh amongst those transported using '108', more than half pregnant women who had a high-risk or complication or emergency went to higher level government hospitals whereas half of the women who did not have any problems went to PHCs and CHCs (table-31). A higher proportion of pregnant women with an emergency used private facilities (23%) compared to those with high-risk (17%) or early complication (13%) or none (10.0%) (table-31). For women who were transported by other means, the proportion of pregnant women who used private facilities was generally higher for all types of outcome: One third of women with any kind of high-risk/complication/emergency, and nearly one quarter of women with none of these, used private facilities (table-31).

Table 31: Type of obstetric complication in pregnant women who called '108' with type of destination hospital

	Transported using '108' ambulance					Not transported by '108' ambulance				
	High-risk in current pregnancy	Complication in current pregnancy	Any emergency at time of call	Any high-risk/ complication/ emergency	None	High-risk in current pregnancy	Complication in current pregnancy	Any emergency at time of call	Any high-risk/ complication/ emergency	None
Andhra Pradesh, %	N=129	N=94	N=43	N=212	N=370	N=52	N=24	N=24	N=83	N=206
Primary Health Centre	15.5	20.2	20.9	19.3	30.5	22.6	35.0	25.0	27.1	28.3
Community Health Centre	10.9	12.8	7.0	11.8	18.1	6.5	15.0	0.0	6.8	17.3
Sub-district / District hospital	56.6	54.3	48.8	52.8	41.4	32.3	35.0	45.0	35.6	30.7
Private clinic / hospital	17.1	12.8	23.3	16.0	10.0	38.7	15.0	40.0	30.5	23.6
Sub-total transported	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Not transported	0.0	0.0	0.0	0.0	0	40.4	16.7	8.3	28.9	38.3
Himachal Pradesh, %	N=166	N=96	N=57	N=252	N=363	N=21	N=17	N=6	N=39	N=72
Primary Health Centre	3.0	4.2	1.8	3.2	3.0	0.0	0.0	0.0	0.0	1.0
Community Health Centre	9.0	6.3	12.3	9.5	11.6	0.0	0.0	16.7	2.6	4.2
Sub-district/ District hospital	86.7	89.6	84.2	86.1	84.6	95.2	94.1	83.3	92.3	91.7
Private clinic / hospital	1.2	0.0	1.8	1.2	0.8	4.8	5.9	0	5.1	1.4
Not transported	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4

In Himachal Pradesh, the type of destination hospital did not vary with type of complications and use of '108'.

In both the states, and amongst the women transported by '108' and those not transported by '108', a higher proportion of women referred by health staff accessed PHCs and CHCs than women who self-referred, who were more likely to access Sub-district and District hospitals, and private hospitals (table-32). There was good evidence for association between the type of referral and type of health facility among women who were transported using '108' in both states, Andhra Pradesh (p=0.014) and Himachal Pradesh (p=0.034).

Table 32: Type of referral with type of destination hospital among pregnant women who called '108'

	Andhra Pradesh, %				Himachal Pradesh, %			
	Transported using '108' ambulance		Not transported by '108' ambulance		Transported using '108' ambulance		Not transported by '108' ambulance	
	Referred by health staff	Referred by self	Referred by health staff	Referred by self	Referred by health staff	Referred by self	Referred by health staff	Referred by self
Destination hospital	N=88	N=494	N=31	N=155	N=93	N=522	N=6	N=104
Primary Health Centre	36.4	24.7	38.7	25.8	2.2	3.3	0.0	1.0
Community Health Centre	17.0	15.6	19.4	12.9	19.4	9.2	0.0	3.8
Sub-district/ District hospital	43.2	46.0	22.6	34.2	77.4	86.6	100.0	91.4
Private clinic / hospital	3.4	13.8	19.4	27.1	1.1	1.0	0.0	2.9
Chi-sq	10.636		3.988		8.695		0.498	
p value	0.014		0.263		0.034		0.919	

4 DISCUSSION

Findings from this study for the state of Andhra Pradesh, along with analysis of data from '108' call centre logs of six states (Chapter 8) (151) and other studies about women who

use publically financed transportation schemes ('108'/'102'/JEY) (164, 182, 186, 202) show that, overall, most '108' users belonged to the disadvantaged social castes, below-the-poverty-line strata and rural areas. These proportions were even higher than expected population proportions. But in Himachal Pradesh, the call to '108' was more frequent among the women belonging to general social caste and above-the-poverty-line strata, although more than one-fifth did not know about their status. Himachal Pradesh has difficult hilly terrain, with long distances to health centres, thus even affluent people prefer using '108' ambulance service as they are assured stabilising care on the route. A quarter of the women who were not assigned an ambulance in Himachal Pradesh in this study were from tribal areas. Several tribal areas in Himachal Pradesh are not connected with roads or are disconnected during heavy snow and rains. Apart from these observations there were no large differences in the socio-economic profile of women in the three transport groups within two states.

Analysis of '108' call centre data for the period 2013-14 found that between 2.7% and 9.3% women transported by '108' had an obstetric emergency, across six states (Chapter 8).(151) Similar proportions were found in this telephone study (4.1% - 9.8%). However on detailed enquiry we observed that a high proportion of women who called '108' reported a high-risk pregnancy or an early complication in pregnancy, information which is not recorded in '108' service logs. Similar to our study, the Indian DLHS-4 survey found that about 40% of women from Andhra Pradesh and from Himachal Pradesh reported a complication of some kind during pregnancy.(199-201) These women may require stabilising care on the way to the delivery facility and the '108' ambulance can play a critical role in managing pre-hospital care. In another study it was found that EMTs in '108' ambulances assisted imminent childbirth, managed the third stage of labour as well as

severe pre-eclampsia and eclampsia cases en-route.(183) However none of the EMTs administered oxytocin for PPH nor did they give Magnesium sulphate to any of the pre-eclampsia and eclampsia case.(183)

The proportion of high-risk and early complications in pregnancy, together, was higher in women who were transported compared to those who called '108' but were not transported. This can be explained by women being aware of their high-risk and complication status early in pregnancy and planning ahead to use '108', and to wait for the ambulance once called. On the other hand, women who reported an obstetric emergency at the time of call were found in higher proportions among the women who called '108' but did not use it. These observations suggest good birth preparedness, with elective decisions to use '108' ambulances for childbirth, but reliance on more promptly available vehicles in cases of emergency. In another study from Andhra Pradesh, the women who perceived any emergency did not wait long for an ambulance, and were more likely to use any transport which was more promptly available.(208) In this study and our study, the women who used transport other than '108' used taxis and auto-rikshaws, which do not provide any en-route stabilising support.

The use of government health centres was more frequent among the women who were transported using '108' and those who did not have any high-risk, early complication or emergency. However, the women who were transported by means other than '108' ambulance, and who were self-referred, were in general more likely to go to higher level government health centres and private facilities. A similar phenomenon of bypassing lower levels of care has been documented in other studies.(15, 76) The findings of our study suggest that the emergency technician in the ambulance, and referring health staff, helped make the decision for the level of facility and made more rational choices. Use of

the free ambulance service, and government facilities for delivery, would of course reduce out of pocket expenditure. Utilisation of health care differed in the two states. In Himachal Pradesh, the vast majority women went to government Sub-district or District hospitals, most likely reflecting poor availability of obstetric services at low level facilities.(209)

Between 15% and 23% women in Andhra Pradesh who had delivered by the time of the interview, and between 13% and 14% in Himachal Pradesh, had a caesarean section. These proportions are higher than those reported in another study on the '108' service (8%).(183) The latter study found that caesarean rates were more likely if the women was from a rural area, was first taken to a PHC, had previous history of caesarean section, or was nulliparous ($p<0.05$).(183) Stillbirth rates recorded in our study were more than twice likely compared to the population rates found in SRS 2011-13 surveys (Stillbirth rate in Andhra Pradesh - 0.5% and Himachal Pradesh - 1.2%).(210) This might be explained by the high proportion of pregnant users of the '108' service who had a high-risk condition or early complication. These women are more likely to have adverse pregnancy outcomes. The neonatal mortality rate in the offspring of '108' users in our study was similar to findings from SRS 2011-13 (NMR in Andhra Pradesh - 26 and Himachal Pradesh - 25 per 1,000 live birth).(210)

4.1 Strengths and Limitations

The study included pregnant women who requested the '108' service but were not transported. This provided an opportunity to compare their characteristics and outcomes with those women who were transported by '108'. The study helped in understanding the choices made with respect to the type of obstetric complication and referrals among '108' users. This could help in developing strategies to strengthen decision making for facility delivery and referral guidelines.

There were a few limitations to this study. The support from the '108' office could not provide lists on holidays, thus for a few days the interviews were conducted within 48 hours rather than 24 hours of the '108' call. Women with emergencies living in hard to reach areas, and those requiring IFTs, were less likely to participate in the study. In Andhra Pradesh, the proportion of callers with unreachable phone numbers were higher, and response rates were lower, in the ambulance not used, and not assigned groups. This may have contributed to selection bias in these groups such that inter-facility referrals and transfers were less likely to be included in this study. As the proportion of emergency cases was not known for those who did not use an ambulance, and for whom an ambulance was not assigned, sample sizes could not be computed for these two groups.

High-risk conditions, early complications in pregnancy, and obstetric emergencies were self-reported by the user, based on known diagnoses or general awareness or perception. Thus these are likely to be inaccurate and may not correspond to the true clinical picture. However, women's perception of their state is an important factor influencing the decision to call '108', and to use the ambulance. We reported pregnancy outcomes both for the mother and the baby but the sample size in our study was small to make valid conclusions. The findings of this study are generalizable only to women who called '108'. A larger comparison group of women who called '108' and did not use it, and an additional group of women who did not call '108' at all, will be required to be able to generalize these finding to the general population.

4.2 Conclusion

A high proportion of women who used a '108' ambulance in Andhra Pradesh were from poor social-economic circumstances compared to the social structure of the general population. But in Himachal Pradesh, which has difficult terrain, '108' ambulance users

were mostly from the general class and tribal women were less likely to receive an ambulance. Although most women called '108' for normal labour pains, about one-third reported a high-risk, or early complication in pregnancy. Less than one in ten women reported an obstetric emergency at the time of call. Women transported using a '108' ambulance were more likely to have early complications and use government facilities than those who called '108' but were not transported. This suggests that the availability of the '108' service has promoted birth preparedness and encouraged elective decisions to use '108' ambulances for childbirth. Women transported using other means were more likely to use private facilities, and one third of those with any high-risk, complication or emergency made use of private services. They most likely did not want to wait for an ambulance to arrive. This would lead to higher out of pocket expenditure. There were no large differences in adverse pregnancy outcomes among those transported using '108' ambulance than those not transported, however larger studies are required to make valid conclusions.

The findings suggest that the '108' service should adopt strategies to reach the poor and unreachable in Himachal Pradesh. Strategies are required to improve the use of '108' services for women who report obstetric emergencies.

SECTION D

Discussion and Recommendations

Discussion and Recommendations-10

CHAPTER 10: DISCUSSION AND RECOMMENDATIONS

My research aimed to study public health referral systems and transport interventions for emergency obstetric care in India, with the overall goal being to identify strategies for improving them. In my research, I have conducted a critical review to assess current referral systems; and a systematic review to assess the proportion of institution referrals for pregnant women in India. I have conducted a survey of health care providers working at the peripheral level to assess their knowledge and practice regarding screening for high-risk conditions and complications, referral decisions, and pre-referral management during pregnancy and childbirth.

For transport of pregnant women, I have conducted a systematic review to assess the effectiveness of transport interventions for pregnant women in India. I have analysed data from the '108' ambulance service for use in obstetric emergencies and IFTs, and surveyed the pregnant users of the '108' ambulance service through telephone interviews.

This chapter summarises the results, discusses the findings, and provides recommendations for improving referral systems for obstetric care in the public health sector in India.

1 MAIN RESEARCH FINDINGS AND DISCUSSION

The literature suggests that India is in the process of upgrading its public sector EmOC services but that standardised obstetric care expected at each level does not yet exist.(48) Moreover, at present, there is no standard referral strategy for pregnant women nor monitoring systems to assess obstetric referrals. Nonetheless, the government has initiated and supported several referral transport interventions for pregnant women,

namely the '108' and '102' ambulance services, *Janani Express Yojana,* and *Janani Shishu Suraksha Karyakaram* (cash support for transport).

Issues of bypassing mid-level facilities, inadequate referral, misdirected referral, unjustified referral, non-compliance, poor communication, and poor quality of services at EmOC are likely to affect the outcome of obstetric referral. There were several knowledge gaps in understanding referral services for pregnant women which were studied in detail in this research.

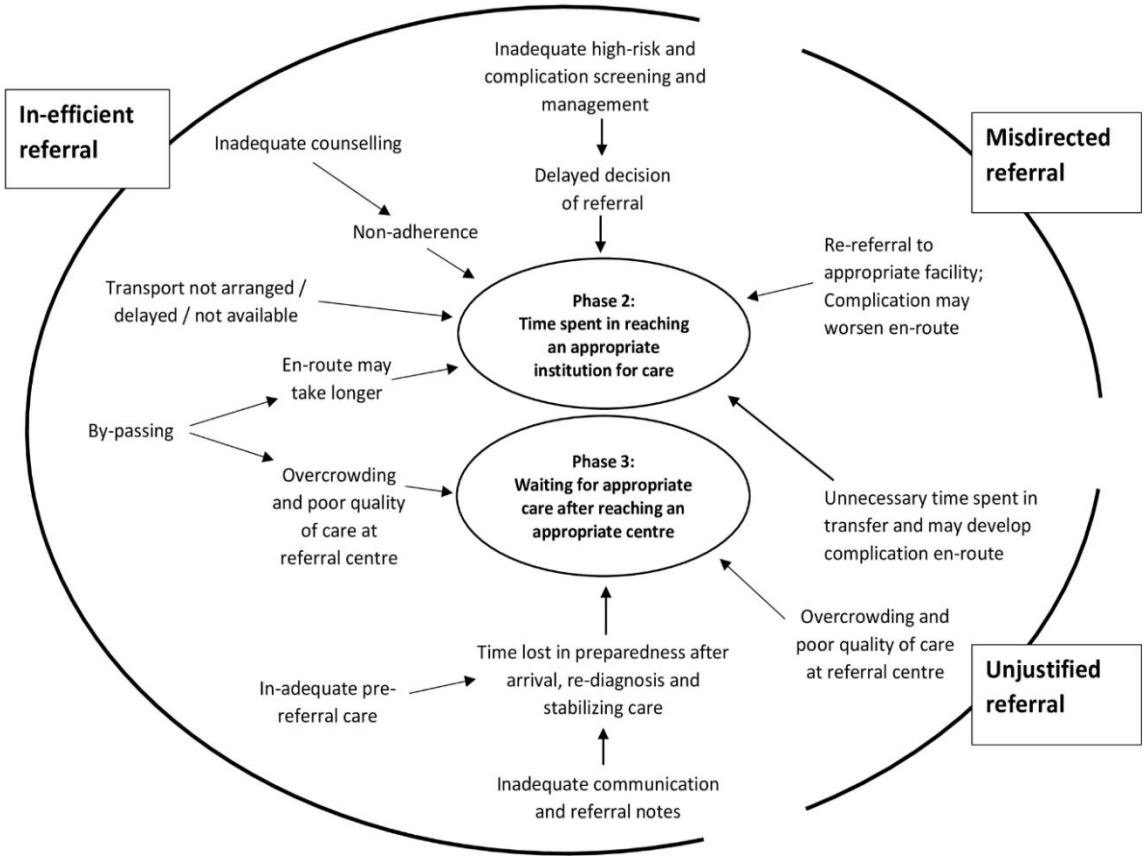
1.1 Burden of obstetric referral in India

Our systematic review to assess the burden of inter-facility referrals found that between 25% and 52% of all antenatal mothers were referred from SHCs for the management of high-risk conditions or complications. Between 14% and 36% of pregnant women were referred from nurse-run birthing centres or BEmOC centres (SHC to PHC), and between 2% and 7% were referred from doctor run BEmOC centres to CEmOC centres (PHC to CHC) for the management of obstetric complications.(114)

Obstetric referrals are a huge burden on the Indian health systems, especially with respect to the need for transportation and management at higher institutions. Inappropriate referrals may contribute to phase II and phase III delays.(15) Figure-23 describes the components of inappropriate institution referral decisions and pre-referral management, contributing to delays in obstetric care as understood from my review.

Problems identified with referrals from peripheral health centres included low skills and confidence of staff for trial of labour in high-risk conditions, reluctance to induce labour, confusion over the clinical criteria for referral, non-uniform standards of care at referral institutions, a tendency to bypass middle level institutions, a lack of referral communication and supervision, and poor compliance.(114)

Figure 23: Inappropriate institution referral decisions and care, and contribution to delays in access to emergency obstetric care (114)



The systematic review identified gaps in in-depth understanding of providers' practices regarding referrals of pregnant women. I followed this up by conducting a KAP survey among health care providers from peripheral health facilities.

1.2 Provider side factors contributing to inefficient obstetric referral

From the KAP survey, I found that the proportion of staff who had received the SBA training was highest in PHCs (84%), lowest in SHCs (50%), and CHCs in between (68%). PHCs and CHCs provided fewer obstetric services compared to the recommended.

1.2.1 Referral for antenatal women

Routine antenatal care and screening were largely provided by ANMs in SHCs, and staff nurses at PHCs and CHCs. We found that a higher proportion of ANMs at SHCs knew about screening for high-risk conditions and early complications, compared to nurses and doctors at PHCs and CHCs, but management by ANMs was poor. ANMs mentioned that they referred women without providing any stabilising treatment. A few respondents referred pregnant women for lab investigations.

Regarding screening, high-risk conditions and early complications in pregnancy that involved taking a case history and lab tests were more likely to be mentioned by health staff than conditions screened by general examination (except blood pressure) and abdominal examination. This may be due to time constraints for examinations because of high patient load, or due to over-reliance on lab investigations. In all, only a quarter of staff in our study mentioned screening for all common high-risk conditions and early complications in pregnancy. Due to such missed opportunities for screening and providing early management, women may present with advanced disease later and receive a delayed referral.

Although knowledge and practice of screening was generally inadequate, most staff felt that it was better to refer women presenting with an existing high-risk condition or complication in early pregnancy because they would not manage childbirth of these women at their centre. The staff were reluctant to manage complications because of the fear of blame should the complication worsen and lead to maternal death. Examples of these conditions were pre-eclampsia, gestational diabetes and previous caesarean section, which should be able to be well managed at PHCs and CHCs. Knowledge of diagnosis and management of pre-eclampsia was good among nurses and ANMs, but most

staff did not administer $MgSO_4$ or antihypertensive treatment to women with pre-eclampsia. Only one-third of care providers prescribed an injection of Dexamethasone or Betamethasone for preterm labour.

Overall, a large proportion of antenatal referrals were likely to be very early, unnecessary, or for investigations, and a smaller proportion were delayed referrals. This, coupled with poor pre-referral management, will worsen pregnancy outcomes. Staff also mentioned instances where referred women who did not have an obstetric emergency (elective referrals) were not readily received at higher facilities. These women had to repeat the booking process as if freshly visiting a health facility. Such inappropriate referrals may make pregnant women choose a private facility closer to home, or a tertiary hospital which could provide the necessary care throughout pregnancy and childbirth.

None of the interventions to improve transport for pregnant women in India have provided transport for elective antenatal referrals. A few voucher schemes are present to promote routine antenatal care and delivery at health facilities, but they do not exclusively provide support for referral transport between facilities.(42) In such case, extremely poor women may not travel to higher centres if they do not perceive the importance of a referral. Whereas in the case of a complication that requires immediate transfer, the '108' and '102' service, as well as *Janani Express Yojana*, would transport such women. Analysis of '108' ambulance data found that less than 1% of all the pregnant users of the '108' services used it for antenatal care or complications such as abortions. This proportion is far less than the estimated total burden of antenatal referrals in the population (25%-52%).(114)

1.2.2 Referral for women in labour

Between 50% and 75% staff reported that they screened for foetal and medical conditions complicating labour. Overall, studies from the developing world have shown low competence in risk assessment, risk monitoring and risk prevention.(57, 131, 133, 139, 141-145) However, evidence from other states in India suggests that after training for using Safe Child-birth Checklists and close supervision, screening for high-risk and complications during childbirth increased markedly.(136-138, 211) Impact on maternal and perinatal mortality was, however, not been established.

The ANMs in our study did not assist deliveries. They referred all the women in labour without providing first-aid. The staff at PHCs managed low-risk deliveries and a few high-risk cases if the mother arrived in a state of full cervical dilatation. Staff at CHCs managed common high-risk conditions but referred women with abnormal foetal conditions, severe anaemia, eclampsia and endocrine conditions (diabetes and thyroid disorders). Although the facilities for obstetric care were only slightly better at CHCs than PHCs, the management of complications was much better at CHCs compared to that provided at PHCs. This could be due to a greater availability of doctors (and an obstetrician in few facilities) and more nursing staff at CHCs. Most CHCs were closer to district health facilities and thus, the staff were ready to take a risk and attempt delivery in complicated cases, and refer only when required.

Deliveries in our study were mostly assisted by staff nurses who were under-confident and relied on doctors' judgments and decisions in cases with complications. A referral was more likely when a doctor was not on duty. A previous study found that pregnant women in India wanted nurses to have higher skill levels and to provide emotional support and respectful treatment.(71, 153) Evidence shows that clinical midwifery in nursing

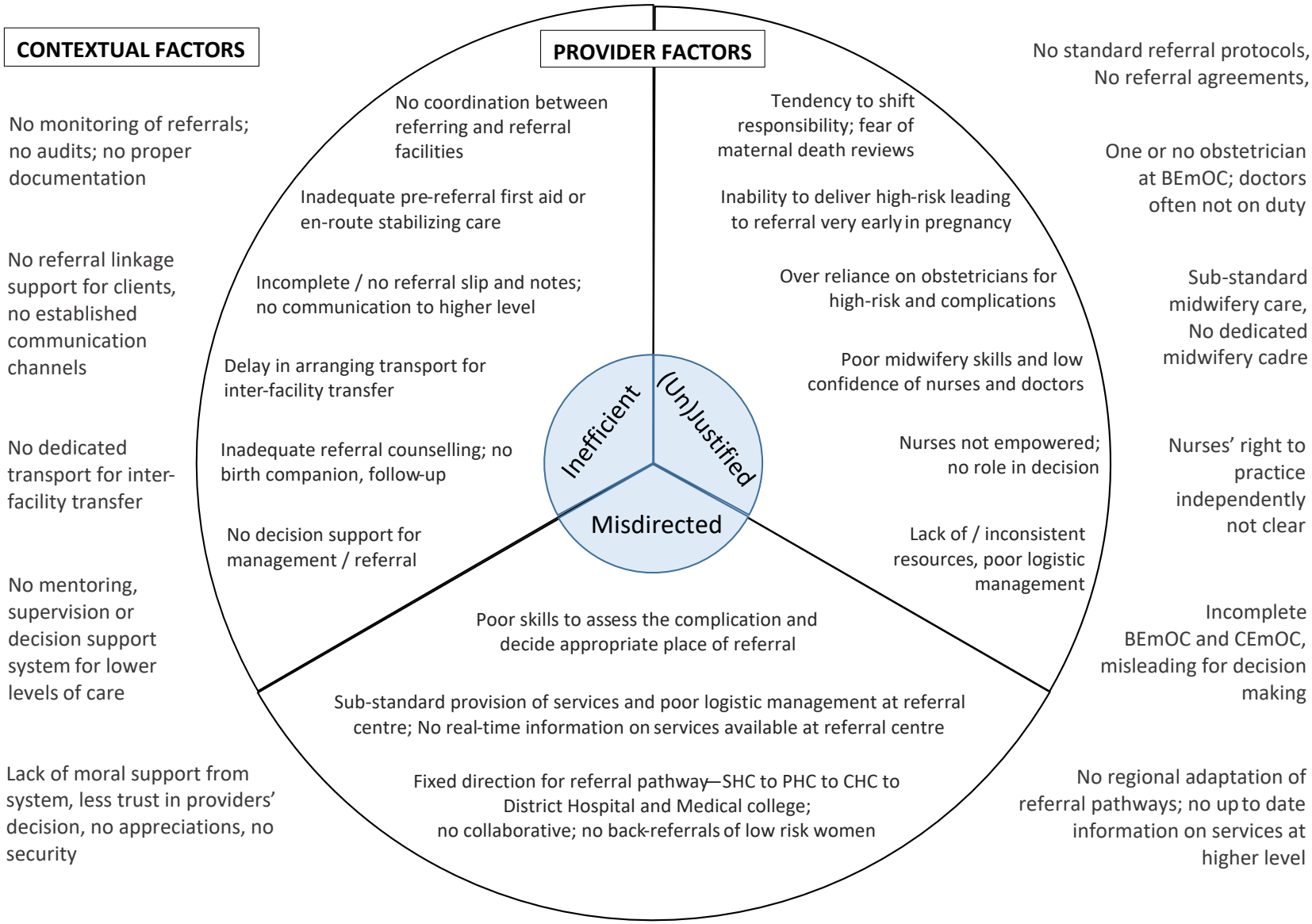
education in India is minimal and only a few care practices are included in the training.(150) Nurses' roles are not well defined and their involvement in obstetric work is restricted due to their unrecognised official status to practice independently.(150)

Health care providers are not provided appropriate support for their clinical decisions, and encouragement while working in difficult conditions. They expected trust, respect and support from the health systems.

Figure-24 summarises the factors contributing to inappropriate referrals. A few factors are justified from the individual provider's perspective, but are unjustified for a formal referral system. This schematic was developed to illustrate a set of key findings of this research. The contextual and provider side factors were similar across the two study states.

Poor capabilities of care systems, poor providers' skills, absence of evidence-based guidelines and referral support leads to a dual problem of access to care—'too little, too late' and 'too much, too soon'—not only for delivery care but also for antenatal care.(212) It is unethical to promote women to receive care in health facilities which are not capable of providing essential obstetric services, and linkage to timely specialist support through appropriate referrals, if needed.(140) Improving the quality of routine antenatal and delivery care together with management of complications and referrals, including transport are pre-requisites for improving maternal and perinatal outcomes.(140, 212, 213) This also warrants strong referral communication and monitoring systems.(140, 213)

Figure 24: Health systems (contextual) and provider factors contributing to inefficient, unjustified and misdirected obstetric referrals in India



1.2.3 Monitoring of referrals for pregnant women

Referral for pregnant women is a complex mechanism and thus poses several challenges. Foremost of these challenges is the unavailability of referral guidelines and protocols; another challenge is improper documentation and feedback for in- or out-referrals in health facilities. Although not standardised, we found that some data were available for admitted women who were later referred. But no records were available for pregnant women who were referred from outpatient clinics. Similarly, some data for pregnant women who used ambulance systems were retrievable but those who used their own vehicles were not recorded in referral registers.

Murray et.al (15) recommends supervision and increasing accountability of care providers. Strand et.al (110) and Konganyuy et.al (111) suggest audits of referrals for obstetric emergencies to improve referral systems for obstetric care and prevention of delays. Monitoring the quality of referrals should be embedded in the monitoring of quality of obstetric care.(140)

My study included only the public health systems facilities and staff. A large proportion of pregnant women access care in private hospitals or clinics either directly or after referral from public health facilities. These utilization patterns are likely to further complicate referral pathways and follow up for these pregnant women. In my KAP survey I could not extract any explicit information on referral to private facilities. The private health facilities, in India, remain unmapped and have several levels of obstetric care provision. It will be difficult to classify them in respect to levels of EmOC. This will also complicate supervision and monitoring the quality of emergency obstetric and referral care.

1.3 Transport for pregnant women

There are several interventions to improve transportation of pregnant women, exclusively or along with general emergencies. The most prominent interventions are the '108' service, the '102' service, and *Janani Express Yojana* where transport service was provided free of charge. There is insufficient evidence to assess the effectiveness of these interventions on institutional delivery, or on maternal or neonatal morbidity or mortality rates. Nonetheless, evidence suggests that free transport service is likely to be used in higher numbers by poor women from backward castes and rural areas.(151) Studies show that travel times were shortest for pregnant women using '108' ambulances compared to women using other ambulance services, or public transport.(37, 164) The paramedics from '108' are expected to be trained in basic emergency obstetric and newborn care.(184) The paramedics supported by call-centre based doctors can provide skilled en-route care to the user.(203)

I estimated that in the six study states, '108' ambulances transferred only 17% of all pregnancies (between 9.0% and 21%) and 21% of all institutional deliveries (between 17% and 29%). The DLHS-4 survey (2012-13) reported that of the institutional deliveries 7%-21% women from study states used an ambulance.(199-201) This evidence clearly suggests that an ambulance was the choice for less than 20% of pregnant women. My analysis also showed that a very small proportion of women who called '108' were not assigned an ambulance (0.0%-2.2%), thus non-availability of an ambulance could not be the main reason for not using an ambulance.

Between 1.3% and 4.8% of the pregnant women have delivered at the pick-up site or en-route in '108' ambulance. A small proportion of transported women had an obstetric emergency or used an ambulance for IFTs. The telephone survey found that one in five

women in Andhra Pradesh underwent caesarean section compared to one in seven in Himachal Pradesh. In Andhra Pradesh, this proportion was less than that reported in DLHS-4 population survey (one in two), but similar in Himachal Pradesh (one in eight).(199-201) It suggests that in Andhra Pradesh, women with complications did not prefer to wait for an ambulance. A study on pregnant users of the '108' service found that caesarean rates were more likely if the woman was from a rural area, was first taken to a PHC, or had the previous history of caesarean section or was nulliparous.(183)

There are no large studies to document if the use of an ambulance or other transport has an impact on pregnancy outcomes, especially among those with high-risk conditions or complications in pregnancy.

1.3.1 Obstetric high-risk conditions, complications and emergencies among women who used the '108' service

The analysis of data found that '108' service transported only 4% (between 3.0% and 13%) of all estimated obstetric emergencies, assuming about 15% of women are expected to experience emergencies. It thus seems that the '108' service was not a preferred choice for women with obstetric emergencies. The women in Andhra Pradesh who perceived an emergency did not wait long and were likely to use alternative transport which was more promptly available.(182) But in Himachal Pradesh where travel distances tend to be long and transport is not easily available, women were more likely to wait for a '108' ambulance.

Women who used the '108' service for obstetric emergencies were more likely to be from rural backgrounds and from lower socio-economic strata of the population.(164, 182, 186) The women with obstetric emergencies travelled longer distances and had longer journey times compared to women without emergencies.(151) This makes it crucial

to provide adequate stabilising care before embarking on, and during the journey. Such women should preferably use adequately equipped ambulances.(140) Women who cannot be managed at middle level of care, or during long journeys, should be directly transferred to the nearest functioning CEmOC.(140)

The telephone survey of pregnant users of the '108' service found that a large proportion (one-third) of women who requested an ambulance for normal labour pains reported either a high-risk condition or an early complication in pregnancy, but a lower proportion had an obstetric emergency. The women who were aware of their high-risk and complication status planned ahead to use '108', and waited for it. The availability of a free ambulance service may have improved access for institutional delivery among the mothers who electively chose to deliver in institutions.

1.3.2 Inter-facility transfers among pregnant women who used '108' service

The '108' service transported only 1% (between 0.6% and 3%) of all estimated institutional deliveries for IFTs. A study from the state of Madhya Pradesh found that about 14% of all women delivering in health facilities, at any level of health facility, were referred to a higher facility for childbirth.(78) This suggests that a small proportion use '108' ambulances for IFTs. However, the proportion of IFTs among all institutional deliveries depend on the pattern of use with regards to the level of health care, referral practices, compliance to referral advice, and the availability of transport for IFTs.(114)

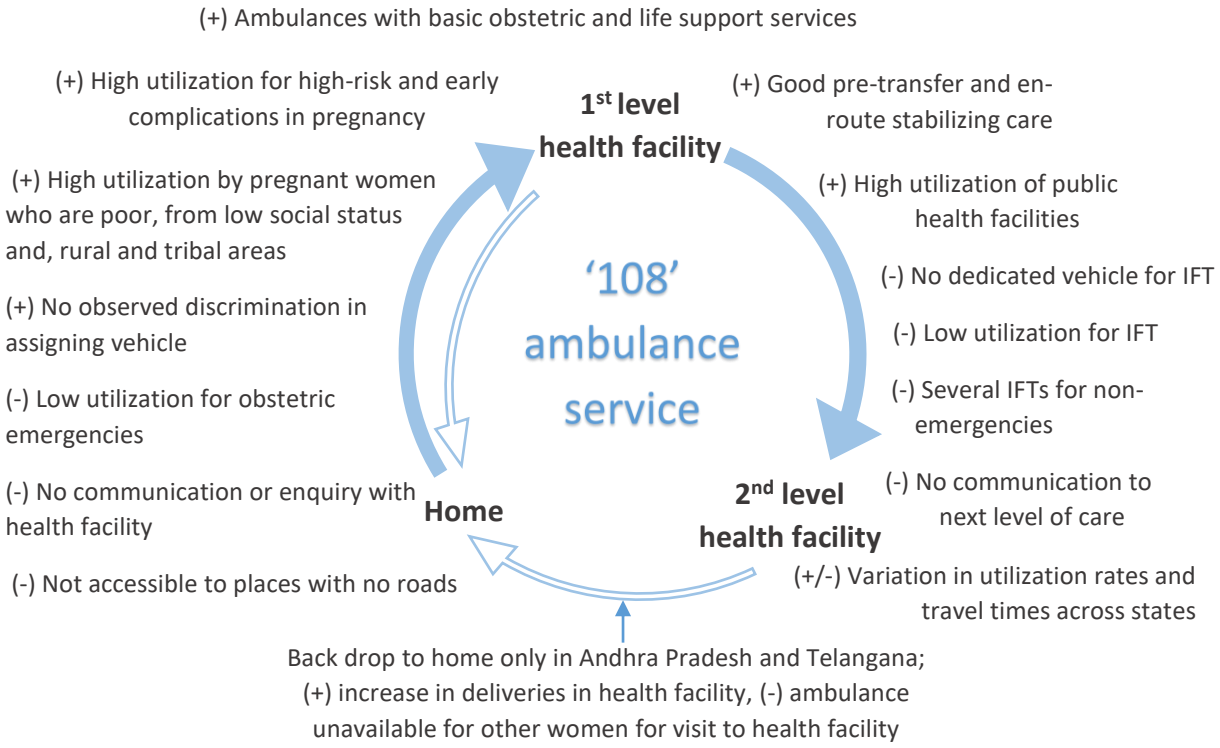
Although obstetric emergencies were twice as high among IFTs than non-IFTs, we found that 92% of IFTs did not have any emergency or complication, with the call-centre based doctor stating that on many occasions, an IFT was not actually required. A recent

study from Madhya Pradesh found that often the IFT was performed because there was no doctor on duty, or other resources were not available.(78)

For all states combined, on adjusted analysis, IFTs were more likely than non-IFTs to be for older and younger women or from urban areas, and less likely to be for women from high-priority districts, from backward or scheduled castes, or women below-the-poverty-line. This could be due to the spaced stationing of ambulances in high-priority or backward geographies, and resulting in limited availability of ambulances. The socio-cultural factors in these populations could be another reason inhibiting use of '108' ambulance for IFT in these populations.

Figure-25 Summarises key features of the '108' service for the transport of pregnant women that have emerged from my research.

Figure 25: Summary of positive (+) and negative (-) features of the '108' ambulance service for transport of pregnant women



Evidence from other studies in India found that the majority of pregnant women who used emergency services (182), and maternal deaths who were transferred between facilities (56, 183), did not use ambulances. In contrast, another study found that a high proportion (two-thirds) of the inter-facility referrals used the *Janani Express Yojana* (non-ambulance), which was the primary free transport (non-ambulance) service available in that state.(78) The utilisation of the publically financed ambulance services vary by state and by type of service.

Experts suggest using combined models incorporating the '108' service with sophisticated ambulances along with '102' or *Janani Express Yojana* which are non-ambulance services.(164, 165, 167, 190) for increased effectiveness. However, utilisation patterns of such combinations for obstetric emergencies and IFTs, and their efficiency, are yet to be assessed.

2 LIMITATIONS OF THE RESEARCH

Both the systematic reviews (one on institution referrals and other on transport for pregnant women) have found only a few relevant studies limiting the assessment of the effectiveness of referrals and transfers. In the providers' KAP survey I did not compute sample size and the study has low statistical power to show compare results between levels of care. The staff may have overstated the practices they follow, but on the positive side, my findings were close to those from other observational studies from India. In the analysis of '108' service logs, the quality of data may be inconsistent. The identification of high-risk and complications are subject to inter-observer and reporting bias. This bias was also likely in the telephone survey of pregnant users of the '108' service. The telephone study did not have sufficient power to assess the impact in terms of maternal or early

neonatal mortality, as it was powered only to estimate the proportion of women with obstetric emergencies among those who called the '108' service.

Further, limitations of the various sub-studies are described in their respective sections.

3 CONCLUSIONS

The proportion of institution referrals is high in India. This is due to the inability of primary health centres to provide basic delivery care and BEmOC services, and a tendency for unjustified referrals to higher institutions. Further, referral systems are sub-standard resulting from an absence of standard guidelines for referral, inadequate referral communication, record maintenance, and the absence of monitoring of referrals for obstetric care.

Staff in peripheral public health centres had sub-optimal knowledge of, and practice in, screening for common high-risk conditions and complications in pregnancy and childbirth. There were large gaps in knowledge of first-aid for obstetric complications. Staff were under-confident, did not have the necessary resources, and felt that some complications should only be managed at the higher level by obstetricians. Staff desired skill building, mentoring, and moral support and motivation from senior officers.

The '108' ambulances are the most prominent free ambulance service for pregnant women in India. Use was more prevalent among the poor, and lower social and economic sections of the population. Of all the estimated institutional deliveries, only a fifth used a '108' ambulance, and a very small proportion made use of it for transfer between facilities. Only a small proportion of journeys made by pregnant women were for obstetric emergency and even among IFTs around 92% did not have any emergency.

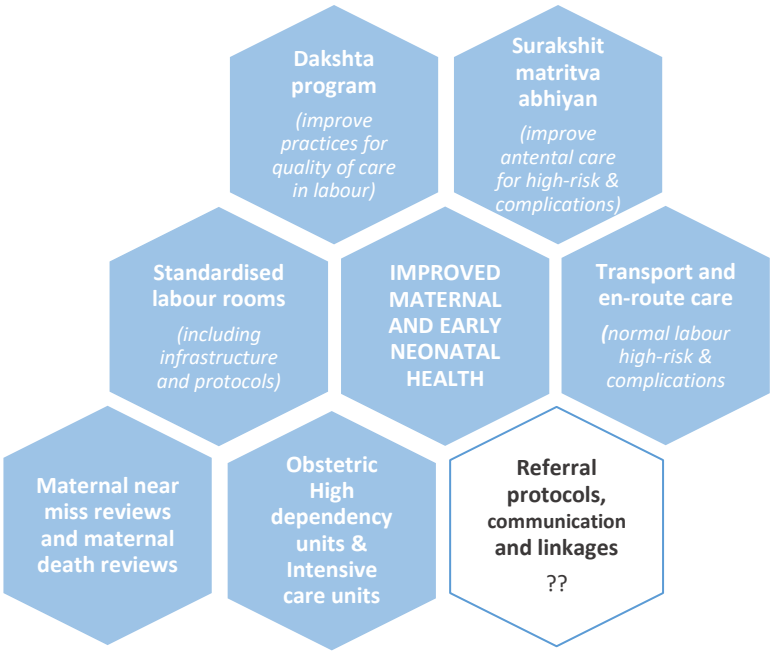
Although most women called '108' for normal labour pains, around one-third reported having a high-risk or early complication in pregnancy. Women transported using '108' ambulance were more likely to use government facilities. Women transported using other means were more likely to have an emergency and they tended to use private facilities.

Health systems should improve the provision of obstetric care by standardising the services at each level of health care, and increase focus on first-aid for complications, appropriate decision-making for referral, and improvements in referral communication. Guidelines and agreements are required to establish referral pathways and continuity of care. Strategies are required to improve the use of '108' services for obstetric emergencies and IFTs. Indicators to monitor referrals should be incorporated in plans for monitoring the quality of obstetric care.

4 RECENT INITIATIVES TO IMPROVE QUALITY OF MATERNAL AND EARLY NEWBORN HEALTH IN INDIA

There were several developments for improving the quality of care in pregnancy and childbirth in India in 2015 and 2016 (figure-26), the period after I had conducted most of my research work. Although these are in initial stages of intervention, they set the stage for recommendations on interventions and further research. I have been involved in some of these activities at the level of advocacy, assessment and evaluation.

Figure 26: Newer initiatives and guidelines in India (2015 and 2016) to improve maternal and early neonatal health at facilities



In 2015, the Government of India had launched the '*Dakshata'* programme to improve the quality of care during childbirth by promoting the use of WHO 29 point checklist supported by close mentoring and supervision. A software application *'Anmol'* is used by ANMs for better documentation, management and follow-up of people at village level. In 2016, the '*Surakshit matritva abhiyan'* was launched to improve the quality of antenatal care. This initiative aims to ensure that each pregnant woman gets access to an obstetrician or medical doctor for comprehensive assessment and management. This initiative can improve timely identification of complications and initiation of management that could reduce need of referrals in future. In 2016, the Government of India also formulated guidelines for improving infrastructure and resources in labour rooms. This includes establishing high dependency units and obstetric ICUs at tertiary settings. The guidelines also include provisions for optimum manpower with appropriate skills and

standard protocols. However referral protocols are not separately specified and this remains a gap.

Nonetheless, the above interventions do contribute indirectly to an improvement in the quality of obstetric referrals. Provision of diagnostics and specialist care to antenatal women will reduce referrals for diagnostics and management of early complications in pregnancy. Improved competencies of staff for management of labour will improve patient management and reduce unjustified referrals. Adherence to treatment protocols will reduce the incidence of obstetric complications, reducing the need for referral. Standardised obstetric care at referral centres, and increased awareness will help in making appropriate referral decisions for place of referral.

While these interventions are yet to be in place, formulating and establishing referral protocols and linkages will ensure the continuum of quality care practices for pregnant women.

5 RECOMMENDATIONS

The goal of my research was to identify strategies for improving the referral systems for emergency obstetric care in India. The following are suggested recommendations for a) future research and b) policy and programme intervention.

5.1 Recommendations for future research

Future research is required in various sub-domains in India, as outlined below.

Community level studies are required to understand the acceptance of referral and transport systems in public health sector. DLHS-4 and NFHS-4 data could be analysed for utilisation patterns of health care and transport services, compliance to referral advice, and outcomes of pregnancy among non-compliers, and non-users of transport

interventions. Geographical Information Services (GIS) based research to accurately map movement, and distance and time taken in travel will help plan referrals and deployment of ambulances.

Further qualitative research is required to understand decision making for obstetric referrals by health care providers. An Expert group should be established to develop clinical referral protocols for different levels of health care service in the Indian context. These protocols should be developed using the best available evidence, and for different health settings. The expert group should also test the feasibility of implementing these referral protocols, their adaptability to local context, and effectiveness in reducing adverse pregnancy outcomes. Quality improvement approaches should be instituted and tested, such as establishing collaboratives of health centres from different levels, to strengthen linkages and promote cross learnings. Referrals of near-miss complication cases should be audited. Implementation research is required to establish and test communication and information systems for referral and transport of pregnant women in India.

Referral systems evolve along with public health systems. Thus, future research should be planned in accordance with developments in the overall public health systems and with a special focus on interventions for improvement in obstetric care.

There is an urgent need to explore and identify indicators to monitor and evaluate referral and transport systems for pregnant women. These indicators should be such that they can be included in routine management information systems (MIS) for obstetric care. The feasibility of collecting quality information on these indicators should be assessed.

5.2 Recommendations for policy and programme intervention

Table-33 summarises my recommendations for improving quality of obstetric referrals. Interventions are suggested in five broad domains:

1. Obstetric referral guidelines and protocols adapted to local needs
2. Communication and decision support system
3. Empowering health staff and moral support
4. Inter-facility transfer transport and en-route care for pregnant women, and
5. Monitoring and evaluation of obstetric referrals and inter-facility transfers

The Government of India is committed to invest in improving infrastructure for, and enhancing the quality, of obstetric care. Simultaneously developing and instituting obstetric referral guidelines and monitoring of referrals will escalate the benefit. With strong information and technology capabilities, India should be able to develop and establish effective low cost IT-based communication and decision support systems. Such support will increase the efficiency of referral systems. Empowering nurses and building their capacity would require revamping of nursing education across the country. Introducing recognised midwifery courses and their placement in public health systems will require strong political commitment and investment. Lastly, exclusive inter-facility transport systems should be considered to improve compliance to referrals and avoid delays, especially for women with complications.

Table 33: Recommendations for strengthening obstetric care, referrals, transfers and monitoring

Recommendation	Purpose	Task
Obstetric referral guidelines and protocols adapted to local needs		
Develop clinical referral and pre-referral management protocols for the state for each level of health care service delivery	• Will help in decision making, well directed referrals, standard pre-referral care, en-route care and ensured support from higher level of care • Will reduce inappropriate, misdirected and delayed referrals	• High level expert committee consisting of obstetricians, public health doctors, nurses, community representatives and other stakeholders to devise clinical guidelines and pilot test them. • Also consider elective referrals
Form referral local and regional collaborative groups, or teams, to ensure continuity of care between facilities Define local referral pathways	• Accessibility to specialist at referral centre by the provider at lower level will improve quality of care, timely decision to referral and quality of pre-referral care. • Will improve readiness for the patient at the referral facility. • Will improve involvement and accountability of specialist.	• States to develop regional collaborative groups and have agreements to establish obstetric teams across levels of care • Each health facility should have its referral directory and referral plan • Form guidelines for these collaborative groups and make them jointly accountable for quality of care and outcomes of pregnancy and childbirth
Communication and decision support system		
Establish communication and decision support across levels of care Ensure appropriate communication and counselling for pregnant women and her family	• Will ensure ready access to expert advice, communicate referral information, arrange transport, and provide feedback. • Will help in follow-up of the case • Will improve confidence of the patient/ family and improve compliance to referral advice. • Will improve supervision and monitoring of referral system.	• States to place help/referral desk within each labour room with direct telephone access to the referral and transport facility. • State to make it mandatory to communicate referral information to next level of care and that patient is transferred only when the referral centre confirms acceptance of the case • State to establish call centre based obstetric decision support for lower level health care providers
Establish real time access to information for services and personnel available at any level of care	• Will help the health care provider at lower level to decide on appropriate referral facility • Will improve accountability of the health systems • Will improve supervision and monitoring of referral system	• State to establish a web based real time information system that will provide information about services (for common complications) and specialist available at any level of care at any given time. • State to ensure such information is available to all health personnel

Empowering health staff and moral support		
Provide moral support to health care providers especially at lower levels of care	• Will improve confidence of staff to own responsibility, take rational decisions and reduce unjustified referrals	• Improve leadership and quality management skills of centre managers • Incentivise and support health care providers at peripheral and mid-level facilities
Support and empower nurses/ midwifes	• Will empower nurses for a bigger role in obstetric care and decision making • Will humanise care and provide respectful care to pregnant women	• Empower nurses to independently provide obstetric care and manage common complications
Inter-facility transfer transport and en-route care for pregnant women		
Ensure dedicated well-equipped ambulances for inter-facility transfers & standardised en-route care in pregnancy	• Will ensure the ambulance is readily available for IFT which will reduce delay and also improve compliance • The dedicated ambulance staff will be better trained and experienced to manage obstetric complication cases	• Place dedicated ambulances for IFTs at peripheral facilities and ensure availability within 10 minutes • Prioritise transport for IFTs over other general ambulance services • Standardise protocols for en-route care and ensure adherence to protocols
Establish communication system between referring facility, ambulance and referral facility	• Will improve continuum of care between facilities and en-route • Will improve quality of care and readiness at the referral facility	• State to establish new or use existing call centre based ambulance systems to establish such communication linkages
Explore mechanisms to provide transport for elective (non-emergency) referrals	• Will improve access for routine care and improve compliance to referral advice especially for poor	• Re-imbursement mechanisms or voucher schemes to be tested to support transfer for elective referrals
Monitoring and evaluation of obstetric referrals and inter-facility transfers		
Identify indicators and mechanisms for monitoring and evaluation of obstetric referrals.	• Will improve accountability of the referral systems • Will help monitor and identify gaps for improvement	• Improve / establish documentation and reporting related to referral care • Assessment of referral systems to be embedded within the routine monitoring and evaluation of obstetric care; identify appropriate indicators • Maternal death reviews and near miss reviews to be used and extended for in-depth assessment of obstetric referrals • A referral collaborative group to be considered as one unit, and assessed for outcomes of referrals

The MMR in India has shown a continuously decreasing trend since 1991 and was estimated at 178 per 100,000 live births in 2012, against the MDG target of 109 per 100,000 live births by 2015. The perinatal death rate in India was estimated at 23 per 1,000 live births in 2015. A large proportion of these maternal and perinatal deaths are preventable. Under the SDGs, India has committed to reducing MMR to 70 per 100,000 live births by 2030 and to end all preventable perinatal deaths. Past reforms such as free ambulance service, *Janani Suraksha Yojana,* and *Janani Sishu Suraksha Karyakaram* have contributed to large improvements in institutional delivery rates. But currently, reforms are required to improve the quality and efficiency of obstetric health care. One such reform would be communication and decision support systems across levels of care to strengthen referrals; and a second would be to provide an adequately skilled human resource for obstetric care, especially a professional midwifery cadre, in India.

SECTION E

Bibliography and Annexes

BIBLIOGRAPHY

1. WHO. Trends in maternal mortality: 1990 to 2015: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. Geneva: WHO; 2015.

2. WHO. Neonatal and Peri-natal mortality: country, regional and global estimates. Geneva: WHO; 2007.

3. UNICEF. The state of the world's children 2009. New York: UNICEF; 2008.

4. UNICEF. Levels & trends in child mortality: Report 2015. Estimates Developed by the UN Inter-agency Group for Child Mortality Estimation United Nations Levels. New York: UNICEF; 2015.

5. United Nations. The Millennium Development Goals report 2014. New York: United Nations; 2014.

6. UNICEF, WHO, UNFPA. Guidelines for monitoring the availability and use of obstetric services. New York: UNICEF; 1997.

7. WHO. Essential elements of obstetric care at first referral level. Geneva: WHO; 1991.

8. Gabrysch S, Civitelli G, Edmond KM, Mathai M, Ali M, Bhutta ZA, et al. New signal functions to measure the ability of health facilities to provide routine and emergency newborn care. PLoS medicine. 2012;9(11):e1001340.

9. Nyamtema AS, Urassa DP, Roosmalen JV. Maternal health interventions in resource limited countries: a systematic review of packages, impacts and factors for change. BMC Pregnancy Childbirth. 2011;11:30.

10. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. Social Sciences Medicine. 1994;38(8):1091-110.

11. Gabrysch S, Campbell OM. Still too far to walk: literature review of the determinants of delivery service use. BMC Pregnancy Childbirth. 2009;9:34.

12. WHO. The World Health Report 2005: Make every mother and child Count. Geneva: WHO; 2005.

13. WHO. Mother-Baby-Package: Implementing safe motherhood in countries, Maternal Health and Safe Motherhood Programme. Geneva: WHO; 1994.

14. Ministry of Health and Family Welfare. Guidelines for antenatal care and skilled attendance at birth by ANMs/LHVs/SNs. New Delhi: Ministry of Health and Family Welfare, Government of India; April 2010.

15. Murray SF, Pearson SC. Maternity referral systems in developing countries: Current knowledge and future research needs. Social Science Medicine. 2006;62(9):2205-15.

16. Jahn A, Kowalewski M, Kimatta SS. Obstetric care in southern Tanzania: does it reach those in need? Tropical Medicine & International Health. 1998;3(11):926-32.

17. Jahn A, De Brouwere V. Referral in pregnancy and childbirth: Concepts and strategies. In: De Brouwere V, Van Lerberghe W, editors. Safe Motherhood Strategies: A review of the Evidence. Antwerp: ITG Press; 2001.

18. Hussein J, Kanguru L, Astin M, Munjanja S. The effectiveness of emergency obstetric referral interventions in developing country settings: A systematic review. PLoS medicine. 2012;9(7):e1001264.

19. WHO. Recommendation on antenatal care for a positive pregnancy experience. Geneva: WHO; 2016.

20. WHO. Standards for improving quality of maternal and newborn care in health facilities. Geneva: WHO; 2016.

21. Registrar General of India. Sample registration system statistical report 2012. New Delhi: Government of India; 2012.

22. World Bank. Data: Birth Rate, crude (per 1,000 people): World Bank; 2012 [Cited 15th September 2017] Available from http://data.worldbank.org/indicator/SP.DYN.CBRT.IN/countries.

23. Registrar General of India. SRS: Maternal Mortality Ratio Bulletin 2011-2013 New Delhi: Government of India; 2014 [Cited 15th September 2017] Available from http://www.censusindia.gov.in/vital_statistics/mmr_bulletin_2011-13.pdf.

24. Registrar General of India. Sample registration system statistical report 2013. New Delhi: Registrar General of India; 2014.

25. Reddy H, Pradhan MR, Ghosh R, Khan AG. India's progress towards the Millennium Development Goals 4 and 5 on infant and maternal mortality. WHO South-East Asia Journal of Public Health. 2012;1(3):279-89.

26. Department of Economic and Social Affairs. Sustainable Development Goal 3: United Nations; 2015 [Cited 15th September 2017] Available from https://sustainabledevelopment.un.org/sdg3.

27. Ministry of Health and Family Welfare. National Rural Health Mission: Framework for Implementation 2005-12. New Delhi: Ministry of Health and Family Welfare, Government of India; 2005.

28. Vora KS, Mavalankar D, Ramani KV, Upadhyaya M, Sharma B, Iyengar S, et al. Maternal health situation in India: A case study. Journal of Health Population & Nutrition. 2009;27(2):184-201.

29. Mavalankar D, Singh A, Patel SR, Desai A, Singh PV. Saving mothers and newborns through an innovative partnership with private sector obstetricians: Chiranjeevi scheme of Gujarat, India. International Journal of Gynecology & Obstetrics. 2009;107(3):271-6.

30. UNFPA. Concurrent assessment of Janai Suraksha Yojana (JSY) scheme in selected states of India. New Delhi: UNFPA; 2008.

31. Randive B, Diwan V, DE Costa A. India's conditional cash transfer programme (the JSY) to promote institutional birth: Is there an association between institutional birth proportion and maternal mortality? PLoS ONE. 2013;8 (6):e67452.

32. Ministry of Health and Family Welfare. A brief note on Janani Shishu Suraksha Karyakram, the new initiative of Ministry of Health and Family Welfare: Ministry of Health and Family Welfare, Government of India; 2011 [Cited 15th September 2017] Available from http://nrhm.gov.in/nrhm-components/rmnch-a/maternal-health/janani-shishu-suraksha-karyakram/background.html.

33. George A. Persistence of high maternal mortality in Koppal district, Karnataka, India: Observed service delivery constraints. Reproductive Health Matters. 2007;15(30):91-102.

34. Subha SB, Sarojini N, Khanna R. An investigation of maternal deaths following public protests in a tribal district of Madhya Pradesh, central India. Reproductive Health Matters. 2012;20(39):11-20.

35. UNICEF, DIFID. Maternal and perinatal death enquiry and response. New Delhi: UNICEF, India; 2008.

36. Vijayashree HY, Elias MA, Patil MR, Anil MH, Raveesha MR, Devadasan N, et al. 'She was referred from one hospital to another': evidence on emergency obstetric care in Karnataka, India. BMC Proceedings. 2012;5(Supp 5):15.

37. Raj SS, Manthri S, Sahoo PK. Emergency referral transport for maternal complication: lessons from the community based maternal death audits in Unnao district, Uttar Pradesh, India. International Journal of Health Policy Management. 2015;4(2):99–106.

38. Ministry of Health and Family Welfare. A strategic approach to Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCH+A) in India. New Delhi: Ministry of Health and Family Welfare, Government of India; 2013.

39. Ministry of Health and Family Welfare. DAKSHATA-Empowering providers for improved MNH care during institutional deliveries. New Delhi: Ministry of Health and Family Welfare, Government of India; 2015.

40. GVK-EMRI. National footprints- Reaching unreachable Hyderabad, AP: GVK EMRI; 2015 [Cited 15th September 2017] Available from http://www.emri.in/our-presence/.

41. Ministry of Health and Family Welfare. EMRI/Patient Transport Service - National Ambulance Service (NAS): Ministry of Health and Family Welfare, Government of India; [cited 2014 12 August]. Available from http://nrhm.gov.in/nrhm-components/health-systems-strengthening/emri-patient-transport-service.html.

42. Ministry of Health and Family Welfare. Directory of innovations implemented in the health Sector. In: Development DoI, editor. New Delhi: Ministry of Health and Family Welfare, Government of India; 2008.

43. Ministry of Health and Family Welfare. District Level Household and Facility Survey-III: 2007-08. New Delhi: Ministry of Health and Family Welfare, Government of India; 2009.

44. IIPS. State Fact sheets, National Family Health Survey India-4. Mumbai: Ministry of Health and Family Welfare, Government of India; 2016 [Cited 15th September 2017] Available from http://rchiips.org/nfhs/factsheet_nfhs-4.shtml.

45. USAID, HLFPPT, SIFPSA. Merrygold Health Network [Cited 15th September 2017] Available from http://merrygold.org.in/MGHN.htm.

46. Ministry of Health and Family Welfare. 6th Common Review Mission Report-2012. New Delhi: Ministry of Health and Family Welfare, Government of India; 2012.

47. Ministry of Health and Family Welfare. National Rural Health Mission: The Journey so Far, 2005-10. New Delhi: Ministry of Health and Family Welfare, Government of India; 2010.

48. Ministry of Health and Family Welfare. Rural health statistics 2014-15. New Delhi: Statistics division,Ministry of Health and Family Welfare, Government of India; 2016.

49. National Health Systems Resource Center. Mapping of MCH centers: NHSRC, Government of India; [Cited 15th September 2017] Available from http://nhsrcindia.org/index.php?option=com_content&view=article&id=290&Itemid=726.

50. Directorate General of Health Services. Indian Public Health Standards (IPHS) Guidelines for Community Health Centers, Revised 2012. New Delhi: Ministry of Health and Family Welfare, Government of India; 2012.

51. Ministry of Health and Family Welfare. Rural Health Statistics in India 2012. New Delhi: Ministry of Health and Family Welfare, Government of India; 2012.

52. Mony PK, Krishnamurthy J, Thomas A, Sankar K, Ramesh BM, Moses S, et al. Availability and Distribution of Emergency Obstetric Care Services in Karnataka State, South India: Access and Equity Considerations. PLoS ONE. 2013 May;8(5):e64126.

53. Ministry of Health and Family Welfare. National Health Policy 2002. New Delhi: Ministry of Health and Family Welfare, Government of India; 2002.

54. Ministry of Health and Family Welfare. National Health Policy 2017. New Delhi: Ministry of Health and Family Welfare, Government of India; 2017. p. 4.

55. Singh S, Murthy GV, Thippaiah AT, Upadhyaya S, Krishna M, Shukla R, et al. Community based maternal death review: Lessons learned from ten districts in Andhra Pradesh, India. Maternal & Child Health Journal. July 2015;19(7):1447-54.

56. Hitesh J. Perceptions and constraints of pregnancy related referrals in rural Rajasthan. Journal of Family Welfare. 1996;42(1):24-9.

57. Ameh C, Msuya S, Hofman J, Raven J, Mathai M, van den Broek N. Status of emergency obstetric care in six developing countries five years before the MDG targets for maternal and newborn health. PLoS ONE. 2012;7(12):e49938.

58. Ministry of Health and Family Welfare. Guidelines for operationalising First Referral Units. New Delhi: Ministry of Health and Family Welfare, Government of India; 2004.

59. David KV, Priscilla RA, Venkatesan S, Rahman SPMF, Kumar GSY, Vijayaselvi R. Outcomes of deliveries in a midwife-run labour room located at an urban health centre: Results of a 5-year retrospective study. The National Medical Journal of India. 2012;25(6):323-6.

60. Salazar M, Vora K, De Costa A. The dominance of the private sector in the provision of emergency obstetric care: studies from Gujarat, India. BMC Health Services Research. 2016;16(255).

61. National Rural Health Mission. Maternity waiting homes: Operational guidelines Bhuvaneshwar: Ministry of Health and Family Welfare, Orissa; 2008 [Cited 15th September 2017] Available from

http://nrhmorissa.gov.in/writereaddata/Upload/Documents/Guideline%20Maternity%20Waiting%20Home%20-%20Copy.pdf.

62. Ministry of Health and Family Welfare. Maternal and Newborn Health Toolkit. In: Division MH, editor. New Delhi: Ministry of Health and Family Welfare, Government of India; 2013. p. 12.

63. Gupta K, Arnold F, Lhungdim H. Health and living conditions in eight Indian cities: NFHS-3. Mumbai: International Institute for Population Sciences; 2009.

64. Islam M, Montgomery M, Taneja S. Urban health and care seeking behaviour: A casestudy of slums in India and the Philippines. Final report The partners for health reformplus project. Bethesda: Abt Associates Inc; 2006.

65. Banga RA, Banga AT, Reddya MH, Deshmukha MD, Baitulea SB, Filippi V. Maternal morbidity during labour and the puerperium in rural homes and the need for medical attention: A prospective observational study in Gadchiroli, India. British Journal of Obstetrics & Gynaecology. March 2004;111(3):231-8.

66. Ministry of Health and Family Welfare. Operational Guidelines on Maternal and Newborn Health. New Delhi: Ministry of Health and Family Welfare, Government of India; 2010.

67. Rani M, Bonu S, Harvey S. Differentials in the quality of antenatal care in India. International Journal of Quality Health Care. 2008;20(1):62-71.

68. More NS, Bapat U, Das S, Alcock G, Patil S, Porel M, et al. Community Mobilization in Mumbai Slums to Improve Perinatal Care and Outcomes: A Cluster Randomized Controlled Trial. PLoS medicine. 2012;9(7):e1001257. doi:10.1371/journal.pmed.

69. Pasha O, Goldenberg RL, McClure EM, Saleem S, Goudar SS, Althabe F, et al. Communities, birth attendants and health facilities: a continuum of emergency maternal and newborn care (the Global Network's EmONC trial). BMC Pregnancy Childbirth. 2010;10(82).

70. International Institute of Population Sciences. National Family Health Survey (NFHS-4): 2015-16. Mumbai: Ministry of Health and Family Welfare, Government of India; 2017.

71. Bhattacharyya S, Issac A, Rajbangshi P, Srivastava A, Avan BI. "Neither we are satisfied nor they"-users and provider's perspective: a qualitative study of maternity care in secondary level public health facilities, Uttar Pradesh, India. BMC Health Services Research. 2015 Sep 27;15:421.

72. Jeffery P, Jeffery R. Only when the boat has started sinking: A maternal death in rural north India. Social Science and Medicine. 2010;71(10):1711-18.

73. Murthy GVS, Thipaiah A, Singh S, Shukla R, Srikrishna SR, Allagh KP. Report of maternal death review in Andhra Pradesh. Hyderabad, India: Indian Institute of Public Health- Hyderabad; 2012.

74. Coffey D. Costs and consequences of a cash transfer for hospital births in a rural district of Uttar Pradesh, India. Social Science & Medicine. 2014;114:89-96.

75. Gutschow K. Going 'Beyond the Numbers': Maternal Death Reviews in India. Medical Anthropology. 2015;35(4):322-37.

76. Agarwal S, Satyavada P, Patra P, Kumar R. Strengthening functional community–provider linkages: Lessons from the Indore urban health programme. Global Public Health. 2008;3(3):308-25.

77. Iyengar K, Iyengar SD. Emergency obstetric care and referral: experience of two midwife-led health centres in rural Rajasthan, India. Reproductive Health Matters. 2009;17(33):9-20.

78. Chaturvedi S, Randive B, Diwan V, De Costa A. Quality of obstetric referral services in India's JSY cash transfer programme for institutional births: A study from Madhya Pradesh province. PLoS ONE. 2014;9(5):e96773.

79. Maitra K, Singh KK, Sekhar C, Saxena BN. A multicentre collaborative study of the care of mothers and infants with a comprehensive MCH care package utilizing high risk approach strategy at primary health centres: Summary, conclusions and recommendations. Indian Pediatrics. 1995;33(1):67-72.

80. Gupta M, Mavalankar D, Trivedi P. A study of referral system for EmOC in Gujarat. 2009 June. [Cited 15th September 2017] Available from http://www.iimahd.ernet.in/publications/data/2009-06-02Gupta.pdf.

81. Biswas AB, Nandy S, Sinha RN, Das DK, Roy RN, Datta S. Status of maternal and newborn care at first referral units in the state of West Bengal. Indian Journal of Public Health. 2004 Jan-Mar;48(1):21-6.

82. Padmanan P, Raman PS, Mavalankar D. Innovations and challenges in reducing maternal mortality in Tamilnadu, India. Journal of Health Population & Nutrition. 2009;27(2):202-19.

83. Kumutha J, Rao GVR, Sridhar BN, Vidyasagar D. The GVK EMRI maternal and neonatal transport system in India: A mega plan for a mammoth problem. Seminars in Fetal & Neonatal Medicine. 2015;20(5):326-34.

84. Mercer SW, Sevar K, Sadutshan TD. Using clinical audit to improve the quality of obstetric care at the Tibetan Delek Hospital in North India: a longitudinal study. Reproductive Health. 2006;3:4.

85. Ministry of Health and Family Welfare. 5 x 5 matrix for High Impact RMNCH+A Interventions: Ministry of Health and Family Welfare, Government of India; [Cited 15th September 2017] Available from http://nrhm.gov.in/images/pdf/programmes/maternal-health/guidelines/RMNCH+A_5x5_matrix.pdf.

86. AbouZahr C. Antepartum and postpartum hemorrhage. Chapter 4. Boston: Harvard School of Public Health; 1998.

87. Campbell OM, Graham WJ. Strategies for reducing maternal mortality: getting on with what works. Lancet. 2006;368(9543):1284-99.

88. University of Bern. STROBE statement: STrengthening the Reporting of OBservational studies in Epidemiology ISPM - University of Bern2009 [Cited 15th September 2017] Available from https://www.strobe-statement.org/index.php?id=strobe-home.

89. CONSORT group. CONSORT: Consolidated Standards of Reporting Trials 2010 [Cited 15th September 2017] Available from http://www.consort-statement.org/.

90. PRISMA. PRISMA Statement 2015 [Cited 15th September 2017] Available from http://prisma-statement.org/PRISMAStatement/.

91. McCord C, Premkumar R, Arole S, Arole R. Efficient and effective emergency obstetric care in a rural Indian community where most deliveries are at home. International Journal of Gynecology & Obstetrics. 2001;75(3):297-307.

92. Barua A, Waghmare R, Venkiteswaran S. Implementing reproductive and child health services in rural Maharashtra, India: A pragmatic approach. Reproductive Health Matters. 2003;11(21):140-9.

93. More NS, Alcock G, Das S, Bapat U, Joshi W, Osrin D. Spoilt for choice? Cross-sectional study of care-seeking for health problems during pregnancy in Mumbai slums. Global Public Health. 2011;6(7):746-59.

94. Alehagen SA, Finnstrom O, Hermansson GV, Somasundaram KV, Bangal VB, Patil A, et al. Nurse-based antenatal and child health care in rural India, implementation and effects - an Indian-Swedish collaboration. Rural and remote health. 2012;12(3):2140.

95. Pasha O, McClure EM, Wright LL, Saleem S, Goudar SS, Chomba E, et al. A combined community- and facility-based approach to improve pregnancy outcomes in low-resource settings: a Global Network cluster randomized trial. BMC Medicine 2013;11:215.

96. Kaul V, Bagga R, Jain V, Gopalan S. The impact of primary postpartum hemorrhage in "near-miss" morbidity and mortality in a tertiary care hospital in North India. Indian Journal of Medical Sciences. 2006;60(6):233-40.

97. Banerjee SK, Andersen KL, Warvadekar J. Pathways and consequences of unsafe abortion: A comparison among women with complications after induced and spontaneous abortions in Madhya Pradesh, India. International Journal of Gynecology & Obstetrics. 2012;118(Suppl. 2):S113-20.

98. Johnston HB, Ved R, Lyall N, Agarwal K. Where do rural women obtain postabortion care? The case of Uttar Pradesh, India. International Family Planning Perspectives. 2003;29(4):182-7.

99. Das V, Agrawal S, Agarwal A. Consequences of delay in obstetric care for maternal and perinatal outcomes. Int J Gynaecol Obstet. 2010;109(1):72-3.

100. Ministry of Health and Family Welfare. Janani Suraksha Yojana: Revised Guidelines for implementation. New Delhi: Ministry of Health and Family Welfare, Government of India; 2006.

101. Department of Public Health and Family Welfare. Innovative schemes and programme interventions under NRHM. Bhopal: Department of Public Health & Family Welfare, Government of Madhya Pradesh; 2010.

102. Jahn A, Kowalewski M. The risk approach in antenatal care: Pitfalls of a global strategy. Curare. 1998;SB15:195-209.

103. Sodani PR, Sharma K. Training needs assessment of public health professionals in maternal and neonatal care. Indian Journal of Maternal & Child Health. 2011;13(4):1-8.

104. Pembe AB, Carlstedt A, Urassa D, Lindmark G, Nyström L, Darj E. Effectiveness of maternal referral system in a rural setting: a case study from Rufiji district, Tanzania. BMC Health Services Research. 2010;10:326.

105. Inter-agency group for safe motherhood. The safe motherhood action agenda: Priorities for the next decade. Colombo, Srilanka: World Bank; 1997.

106. Vanneste AM, Ronsmans C, Chakraborty J, De Francisco A. Prenatal screening in rural Bangladesh: from prediction to care. Health Policy & Planning. 2000;15(1):1-10.

107. McDonagh M. Is antenatal care effective in reducing maternal morbidity and mortality? Health Policy & Planning. 1996;11:1-15.

108. Biswas AB, Das DK, Misra R, Roy RN, Ghosh D, Mitra K. Availability and use of emergency obstetric care services in four districts of West Bengal, India. Journal of Health Population & Nutrition. 2005;23(3):266-74.

109. Fauveau V, Donnay F. Can the process indicators for emergency obstetric care assess the progress of maternal mortality reduction programs? An examination of UNFPA Projects 2000—2004. International Journal of Gynecology & Obstetrics. 2006;93(3):308-16.

110. Strand RT, de Campos PA, Paulsson G, de Oliveria J, Bergstorm S. Audit of referrals of obstetric emergencies in Angola: A tool for assessing quality of care. African Journal of Reproductive Health. 2009;13(2):75-85.

111. Kongnyuy EJ, Mlava G, van den Broek N. Criteria-based audit to improve a district referral system in Malawi: a pilot study. BMC Health Services Research. 2008;8:190.

112. Kobusingye OC, Hyder AA, Bishai D, Hicks ER, Mock C, Joshipura M. Emergency medical systems in low- and middle-income countries: recommendations for action. Bulletin of the World Health Organization. 2005;88(8):626-31.

113. WHO. Strategies toward ending preventable maternal mortality (EPMM). Geneva: WHO; 2015.

114. Singh S, Doyle P, Campbell OM, Mathew M, Murthy GVS. Referrals between public sector health institutions for women with obstetric high-risk, complications, or emergencies in India –A systematic review. PLoS ONE 2016;11(8):e0159793.

115. WHO, UNFPA, UNICEF, AMDD. Monitoring emergency obstetric care: a handbook. Geneva; WHO: 2009.

116. Majrooh MA, Hasnain S, Akram J, Siddiqui A, Memon ZA. Coverage and quality of antenatal care provided at primary health care facilities in the 'Punjab' province of 'Pakistan'. PLoS ONE. 2014;9(11):e113390.

117. Bucher S, Marete I, Tenge C, Liechty EA, Esamai F, Patel A, et al. A prospective observational description of frequency and timing of antenatal care attendance and coverage of selected interventions from sites in Argentina, Guatemala, India, Kenya, Pakistan and Zambia. Reproductive Health. 2015;12 (Suppl 2):S12.

118. Kyei NNA, Chansa C, Gabrysch S. Quality of antenatal care in Zambia: a national assessment. BMC Pregnancy Childbirth. 2012;12:151.

119. Naariyong S, Poudel KC, Rahman M, Yasuoka J, Otsuka K, Jimba M. Quality of antenatal care services in the Birim north district of Ghana: contribution of the Community-based health planning and services program. Maternal & Child Health Journal. 2011;16(8):1709-17.

120. Boller C, Wyss K, Mtasiwa D, Tanner M. Quality and comparison of antenatal care in public and private providers in the United Republic of Tanzania. Bulletin of the World Health Organisation. 2003;81(2):116-22.

121. Manithip C, Edin K, Sihavong A, Wahlstr¨om R, Wessel H. Poor quality of antenatal care services—Is lack of competence and support the reason? An observational and interview study in rural areas of Lao PDR. Midwifery. 2013;29(3):195-202.

122. Yeoh PL, Hornetz K, Shauki NIA, Dahlui M. Assessing the extent of adherence to the recommended antenatal care content in Malaysia: Room for improvement. PLoS ONE. 2015;10(8):e0135301.

123. Yeoh PL, Hornetz K, Dahlui M. Antenatal care utilisation and content between low-risk and high-risk pregnant women. PLoS ONE. 2016;11(3):e0152167.

124. Dhar RS, Nagpal J, Bhargava V, Sachdeva A, Bhartia A. Quality of care, maternal attitude and common physician practices across the socio-economic spectrum: a community survey. Archives of Gynecology and Obstetrics. 2010;282(3):245-54.

125. Victora C, Matijasevich A, Silveira M, Santos I, Barros A, Barros F. Socio-economic and ethnic group inequities in antenatal care quality in the public and private sector in Brazil. Health policy & planning. 2010;25(4):253-61.

126. Handler A, Rankin K, Rosenberg D, Sinha K. Extent of documented adherence to recommended prenatal care content: provider site differences and effect on outcomes among low-income women. Maternal & Child Health Journal. 2012;16(2):393-405.

127. Yoong AF, Lim J, Hudson CN, Chard T. Audit of compliance with antenatal protocols. BMJ. 1992;305(6863):1184-6.

128. White DE, Fraser-Lee NJ, Tough S, Newburn-Cook CV. The content of prenatal care and its relationship to preterm birth in Alberta, Canada. Health Care for Women International. 2006;27(9):777-92.

129. Simkhada B, Teijlingen ER, Porter M, Simkhada P. Factors affecting the utilization of antenatal care in developing countries: Systematic review of the literature. Journal of Advanced Nursing. 2008;61(3):244-60.

130. Ramadurg U, Vidler M, Charanthimath M, Katageri G, Bellad M, Mallapur A, et al. Community health worker knowledge and management of pre-eclampsia in rural Karnataka State, India. Reproductive Health. 2016;13(Suppl 2):113.

131. MCHIP. Quality of antenatal and delivery care services in six countries in Sub-Saharan Africa. USAID.

132. Berrueta M, Foday JH, Thorsten VR, Goldenberg RL, Carlo WA, Garces A, et al. Use of antenatal corticosteroids at health facilities and communities in low-and middle income countries. Reproductive health. 2016 May 27;13(1):66.

133. Brenner S, De Allegri M, Gabrysch S, Chinkhumba J, Sarker M, Muula AS. The quality of clinical maternal and neonatal healthcare - a strategy for identifying 'routine care signal functions'. PLoS ONE. 2015 April 15;10(4):e0123968.

134. Duysburgh E, Zhang WH, Ye M, Williams A, Massawe S, Si A, et al. Quality of antenatal and childbirth care in selected rural health facilities in Burkina Faso, Ghana and Tanzania: Similar finding. Tropical Medicine & International Health. 2013;18(5):534-47.

135. Chaturvedi S, De Costa A, Raven J. Does the Janani Suraksha Yojana cash transfer programme to promote facility births in India ensure skilled birth attendance? A qualitative study of intrapartum care in Madhya Pradesh. Global Health Action. 2015 Jul 7;8:27427.

136. Iyengar K, Jain M, Thomas S, Dashora K, Liu W, Saini P, et al. Adherence to evidence based care practices for childbirth before and after a quality improvement intervention in health facilities of Rajasthan, India. BMC Pregnancy Childbirth. 2014;14:270.

137. Kumar S, Yadav V, Balasubramaniam S, Jain Y, Joshi CS, Saran K, et al. Effectiveness of the WHO SCC on improving adherence to essential practices during childbirth, in resource constrained settings. BMC Pregnancy Childbirth. 2016;16:345.

138. Spector JM, Agarwal P, Kodkany B, Lipsitz S, Lashoher A, Dziekan G, et al. Improving quality of care for maternal and newborn health: prospective pilot study of the WHO safe childbirth checklist program. PLoS ONE. 2012;7(5):e35151.

139. Chaturvedi S, Upadhyay S, De Costa A. Competence of birth attendants at providing emergency obstetric care under India's JSY conditional cash transfer program for institutional delivery: An assessment using case vignettes in Madhya Pradesh province. BMC Pregnancy Childbirth. 2014 May 24;14:174.

140. Campbell OMR, Calvert C, Testa A, Strehlow M, Benova L, Keyes E, et al. The scale, scope, coverage, and capability of childbirth care. The Lancet. 2016 Oct 29;388(10056):2193-208.

141. Edson W, Burkhalter B, McCaw-Binns A. Timeliness of care for eclampsia and pre-eclampsia in Benin, Ecuador, and Jamaica. Int J Gynaecol Obstet. 2007;97(3):209-14.

142. Iyengar SD, Iyengar K, Suhalka V. A comparison of domiciliary and institutional delivery practices in rural Rajasthan, India. Journal of Health Population & Nutrition. 2009;27(2):303-12.

143. Gabrysch S, Zanger P, Seneviratne HR, Mbewe R, Campbell OM. Tracking progress towards safe motherhood: meeting the benchmark yet missing the goal? An appeal for better use of health-system output indicators with evidence from Zambia and Sri Lanka. Tropical Medicine & International Health. 2011;16(5):627-39.

144. Filippi V, Richard F, Lange I, Ouattara F. Identifying barriers from home to the appropriate hospital through near-miss audits in developing countries. Best Pract Res Clin Obstet Gynaecol. 2009;23(3):389-400.

145. Lalonde A. Prevention and treatment of postpartum hemorrhage in low-resource settings. Int J Gynaecol Obstet. 2012;117(2):108-18.

146. Chaturvedi S, Upadhyay S, De Costa A, Raven J. Implementation of the partograph in India's JSY cash transfer programme for facility births: A mixed methods study in Madhya Pradesh province. BMJ Open. 2015;5(4):e006211.

147. Brhlikova P, Jeffery P, Bhatia GP, Khurana S. Intrapartum oxytocin (mis) use in South Asia. Journal of Health Studies. 2009;2(1):33-50.

148. Kulkarni R, Chauhan S, Daver R, Nandanwar Y, Patil A, Bhosale A. Prospective observational study of near-miss obstetric events at two tertiary hospitals in Mumbai, Maharashtra, India. Int J Gynaecol Obstet. 2016;132(2):170-3.

149. Stephens L. Midwifery-ledcare. In: Reid, Lindsay, editors. Midwifery Freedom to Practice? An International Exploration of Midwifery Practice. Philadelphia: Churchill Livingstone, Elsevier; 2007. p. 144.

150. Sharma B, Johansson E, Prakasamma M, Mavalankar D, Christensson K. Midwifery scope of practice among staff nurses: a grounded theory study in Gujarat, India. Midwifery. 2013;29(6):628-36.

151. Singh S, Doyle P, Campbell OM, Oakley L, Rao GVR, Murthy GVS. Transport of pregnant women and obstetric emergencies in India: An analysis of '108' ambulance service system data. BMC Pregnancy Childbirth. 2016;16:299.

152. Issac A, Chatterjee S, Srivastava A, Bhattacharyya S. Out of pocket expenditure to deliver at public health facilities in India: a cross sectional analysis. Reproductive Health. 2016;13(1):99.

153. Bhattacharyya S, Srivastava A, Avan BI. Delivery should happen soon and my pain will be reduced: understanding women's perception of good delivery care in India. Global Health Action. 2013 Nov 22;6:22635.

154. Renfrew MJ, McFadden A, Bastos MH, Campbell J, Channon AA, Cheung NF, et al. Midwifery and quality care: findings from a new evidence-informed framework for maternal and newborn care. The Lancet. 2014;384(9948):1129-45.

155. Chaturvedi S, Randive B, Raven J, Diwan V, De Costa A. Assessment of the quality of clinical documentation in India's JSY cash transfer program for facility births in Madhya Pradesh. Int J Gynaecol Obstet. 2016;132(2):179-83.

156. Murray SF, Davies S, Phiri RK, Ahmed Y. Tools for monitoring the effectiveness of district maternity referral systems. Health Policy & Planning. 2001;16(4):353-61.

157. Ganatra BR, Coyaji KJ, Rao VN. Too far, too little, too late: a community-based case-control study of maternal mortality in rural west Maharashtra, India. Bulletin of the World Health Organization. 1998;76(6):591-98.

158. Iyengar K, Iyengar SD, Suhalka V, Dashora K. Pregnancy-related deaths in rural Rajasthan, India: exploring causes, context, and care-seeking through verbal autopsy. Journal of Health Population & Nutrition. 2009 April;27(2):293-302.

159. Schoon MG. Impact of inter-facility transport on maternal mortality in the Free State Province. South African Medical Journal. 2013;103(8).

160. UNFPA. The UNFPA Emergency Obstetric Care Checklist for Planners. New York, USA: UNFPA; 2002.

161. Ministry of Health and Family Welfare. NRHM- Meeting people's health needs in patnership with states: The Journey so far, 2005-2010. New Delhi: Ministry of Health and Family Welfare, Government of India; 2011.

162. Raj AX. Saving lives through rural ambulance services: Experiences from Karnataka and Tamil Nadu states, India. Transport and Communications Bulletin for Asia and the Pacific. 2014;84:52-66.

163. National Health Mission. Janani Shishu Suraksha Karyakaram (JSSK): Ministry of Health and Family Welfare, Government of India; 2012 [Cited 15th September 2017] Available from

http://www.nhp.gov.in/health-programmes/national-health-programmes/janani-shishu-suraksha-karyakaram-jssk.

164. Sundararaman T, Chakraborty G, Nair A, Mokashi T, Ved R. Publicly Financed Emergency Response and Patient Transport Systems Under NRHM. New Delhi: Government of India; 2012.

165. National Health Systems Resource Center. Emergency Medical Services (EMS) in India: A concept paper. Delhi: Ministry of Health and Family Welfare, Government of India; 2010.

166. National Health Mission. ERS/Patient Transport Service: National Ambulance Service (NAS): Ministry of Health and Family Welfare, Government of India; 2015 [Cited 15th September 2017] Available from http://nrhm.gov.in/nrhm-components/health-systems-strengthening/emri-patient-transport-service.html.

167. GVK-EMRI. Our presence Hyderabad2016 [Cited 15th September 2017] Available from http://www.emri.in/our-presence/.

168. Access Health International. GVK Emergency Management Research Institute: operating the 108 emergency care model. Hyderabad: Access Health International; 2013.

169. IDEO. Case Study: GVK EMRI. World Bank & IDEO.org; 2013.

170. Technical management support team. Rapid Review of Janani Express in Orrissa. Bhuvaneshwar: National Rural Health Mission; 2010.

171. Governance Knowledge Centre. Janani Express Yojana: Health referral transport facility. New Delhi: Department of Administrative Reforms and Public Greivances; 2012.

172. Tamil Nadu Health Systems Project. '108' Emergency management services performance report. Chennai: Tamil Nadu Health Systems Project, Government of Tamilnadu; 2013.

173. Pandey A, Ranjan R. Emergency (108) calls to the ambulance service in the state of Gujarat (Inida) that do not result in the patient being transported to hospital: An epidemiological study. Journal of Clinical & Diagnostic Research. 2009;3(3):1519-22.

174. Chaman P. Impact of emergency medical support services on public health delivery system in Goa. BMC Proceedings. 2012;6(Supp 1):14.

175. Jagadeesha H. Utilisation of EMRI 108 service and associated factors in Bengluru urban district, Karnataka, India. Chennai: National Institute of Epidemiology, ICMR; 2011.

176. National Health Systems Resource Center. Study of Emergency response service - EMRI model. New Delhi: Ministry of Health and Family Welfare, Government of India; 2009.

177. Bolla CR, Dudala SR, Rao AR, Bandara S, Patki MB, Ravikumar BP. Utilization of Emergency Management and Research Institute (108 EMRI): An emergency response service in Khammam district, Andhra Pradesh, India. Journal of Human Ecology. 2011;34(1):49-52.

178. IHMR Banglore. An evaluation study on emergency response services (EMRI Model 108 in Karnataka). Banglore: Institute of health management research, Banglore; 2013.

179. Nandan D, Mishra A, Tiwari VK, Nair KS. An assessment of Janani express yojana in the state of Madhya Pradesh. Gwalior. New Delhi: National Institute of Health & Family Welfare , Government of India; 2010.

180. Prinja S, Jeet G, Kaur M, Aggarwal AK, Manchanda N, Kumar R. Impact of referral transport system on institutional deliveries in Haryana, India. Indian Journal of Medical Research. June 2014;139(6):883-91.

181. Prinja S, Manchanda N, Aggarwal AK, Kaur M, Jeet G, Kumar R. Cost & efficiency evaluation of a publicly financed & publicly delivered referral transport service model in three districts of Haryana State, India. Indian Journal of Medical Research. 2013;138(6):1003-11.

182. Surendra G, Pattnaik GS, Dinesh E, Murali D, Anantharao R, Daniel VS, et al. A study of Emergency Response Services in three Districts of Andhra Pradesh. Hyderabad: The Institute of Health Systems; 2011.

183. Strehlow MC, Newberry JA, Bills CB, Hyeyoun (Elise) Min, Evensen AE, Leeman L, et al. Characteristics and outcomes of women using emergency medical services for thirdtrimester pregnancy-related problems in India: a prospective observational study. BMJ Open. 2016;6(7):e011459.

184. Raj GF. Importance of effective emergency medical transport in addressing maternal complications: Case study, EMRI 108 EMS service in Andhra Pradesh. Journal of Emergency Medicine, GVK-EMRI. 2009;2:6-15.

185. Jena B, Bhardwaj D, Rao GVR. Strategy towards achieving safe motherhood in India: A Case study of GVK EMRI. 2011.

186. Prinja S, Bahuguna P, Lakshmi PVM, Mokashi T, Aggarwal AK, Kaur M, et al. Evaluation of publicly financed and privately delivered model of emergency referral services for maternal and child health care in India. Plos ONE. 2014;9(10):e109911.

187. Sidney K, Ryan K, Diwan V, De Costa A. Utilization of a State Run Public Private Emergency Transportation Service Exclusively for Childbirth: The Janani (Maternal) Express Program in Madhya Pradesh, India. PLoS ONE. 2014;9(5):e96287.

188. Sabde Y, De Costa A, Diwan V. A spatial analysis to study access to emergency obstetric transport services under the public private "Janani Express Yojana" program in two districts of Madhya Pradesh, India. Reproductive Health. 2014;11(57).

189. National Health Systems Resource Center. Publicly Financed Emergency Response and Patient Transport Systems Under NRHM. New Delhi: Ministry of Health and Family Welfare, Government of India; 2012.

190. Ziqitza. Ambulance services 2016 [Cited 15th September 2017] Available from http://zhl.org.in/our-services/ambulance-services/dial-108.html.

191. Holmes W, Kennedy E. Reaching emergency obstetric care: overcoming the 'second delay'. Melbourne, Australia: Burnet Institute on behalf of Compass, the Women's and Children's Health Knowledge Hub; 2010.

192. Hohlagschwandtner M, Husslein P, Klebermass K, Weninger M, Nardi A, Langer M. Perinatal mortality and morbidity. Comparison between maternal transport, neonatal transport and inpatient antenatal treatment. Archives of Gynecology and Obstetrics. 2001;265(3):113-8.

193. Shehu D, Ikeh AT, Kunaa MJ. Mobilizing transport for obstetric emergencies in northwestern Nigeria. International Journal of Gynecology & Obstetrics. 1997;59(Supp. 2):S173-S80.

194. Giovine A, Ostrowski C. Technical report on improving transportation and referral for maternal health: Knowledge gaps and recommendations. Washington DC: Woodrow Wilson International Center for Scholars (WWICS); 2010.

195. UNICEF. Operating perinatal referral transport services in rural India: A toolkit. New Delhi: UNICEF; 2010.

196. Ministry of Health and Family Welfare. Guidance note for implementation of RMNCH+A interventions in High Priority Districts. New Delhi: Ministry of Health and Family Welfare, Government of India; 2013.

197. National Rural Health Mission. Formulas for calculating health and family planning indicators: Ministry of Health and Family Welfare, Government of India; 2008 [Cited 15th September 2017] Available from http://pbnrhm.org/formulas/health_indicators.pdf.

198. White IR, Carlin JB. Bias and efficiency of multiple imputation compared with complete-case analysis for missing covariate values. Statistics in Medicine. 2010;29(28):2920-31.

199. IIPS. Telangana: District level household and facility survey (2012-13) Mumbai: Ministry of Health and Family Welfare, Government of India; 2014 [Cited 15th September 2017] Available from https://nrhm-mis.nic.in/DLHS4/Reports/Telangana.pdf.

200. IIPS. Andhra Pradesh: District level household and facility survey (2012-13) Mumbai: Ministry of Health and Family Welfare, Government of India; 2014 [Cited 15th September 2017] Available from https://nrhm-mis.nic.in/DLHS4/Reports/Andhra%20Pradesh.pdf.

201. IIPS. Himachal Pradesh: District level household and facility survey (2012-13) Mumbai: Ministry of Health and Family Welfare, Government of India; 2014 [Cited 15th September 2017] Available from https://nrhm-mis.nic.in/DLHS4/Reports/Himachal%20Pradesh.pdf.

202. Prinja S, Aggarwal AK, Kaur M. Evaluation of Haryana emergency ambulance services. New Delhi: PGIMER, Chandigarh & NHSRC; 2011.

203. McLelland GE, Morgan AE, McKenna LG. Involvement of emergency medical services at unplanned births before arrival to hospital: a structured review. Emergency Medicine Journal. 2014;31(4):345-50.

204. Ronsmans C, Graham WJ, Lancet Maternal Survival Series steering group. Maternal mortality: who, when, where, and why. Lancet. 2006 Sep 30;368(9542):1189-200.

205. Singh S, Doyle P, Campbell OM, Rao GVR, Murthy GVS. Inter-facility transfer of pregnant women using publicly-funded emergency call-centre based ambulance services- Cross-sectional analysis of service logs from five states in India. BMJ Open. 2016 June 9;7(6):e015077.

206. Raul Artal M. Overview of high-risk pregnancy. 2015. In: Merck Manual [Internet]. New Jersey: Merck Publishings. [Cited 15th September 2017] Available from https://www.merckmanuals.com/professional/gynecology-and-obstetrics/high-risk-pregnancy/overview-of-high-risk-pregnancy.

207. CDC. Pregnancy complications Atlanta: Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion; 2016 [Cited 15th September 2017] Available from http://www.cdc.gov/reproductivehealth/maternalinfanthealth/pregcomplications.htm.

208. Institute of Health Systems. A study of emergency response services in three districts of Andhra Pradesh. Hyderabad: Institute of Health Systems; 2011.

209. Ministry of Health and Family Welfare. Rural Health Statistics in India 2013-14. New Delhi: Ministry of Health and Family Welfare, Government of India; 2014 [Cited 15th September 2017] Available from https://nrhm-mis.nic.in/RURAL%20HEALTH%20STATISTICS/(A)%20RHS%20-%202014/Status%20of%20Facilities%20Available.pdf. .

210. Registrar General of India. Special bulletin on Maternal Mortality in India 2010-2012: Sample Registration System. New Delhi: Government of India; 2013.

211. Delaney MM, Maji P, Kalita T, Kara N, Rana D, Kumar K, et al. Improving adherence to essential birth practices using the WHO Safe Childbirth Checklist with peer coaching: Experience from 60 public health facilities in Uttar Pradesh, India. Global Health: Science & Practice. 2017;5(2):217-31.

212. Miller S, Abalos E, Chamillard M, Ciapponi A, Colaci D, Comandé D, et al. Beyond too little, too late and too much, too soon: a pathway towards evidence-based, respectful maternity care worldwide. The Lancet. 2016;388(10056):2176-92.

213. Koblinsky M, Moyer CA, Calvert C, Campbell J, Campbell OMR, Feigl AB, et al. Quality maternity care for every woman, everywhere: a call to action. The Lancet. 2016;388(10057):2307-20.

214. WHO. Making preganncy safer: the critical role of the skilled attendant. A joint statement by WHO, ICM and FIGO Geneva: WHO; 2004.

215. Say L, Souza JP, Pattinson RC. Maternal near miss--towards a standard tool for monitoring quality of maternal health care. Best Pract Res Clin Obstet Gynaecol. 2009;23(3):287-96.

216. WHO. Report on the World Health Organization Working Group on the Classification of Maternal Deaths and Severe Maternal Morbidities. Geneva: WHO; 2009.

ANNEXES

ANNEX I: DEFINITIONS

1.1 Type of Referrals in relationship with care for pregnancy, delivery and post-delivery (17)

1.1.1 Based on who decided for referral

i. Self-referrals: When client seeks care at higher level health facility by deciding themselves rather than going to a primary level health facility and then referred onwards to higher level.

ii. Community health worker referrals: When a community health worker or Traditional birth attendant (TBA), also called *Dai* locally, refers the client to higher level health facility.

iii. Institution referrals: When client seek care at a primary level health facility and is referred onwards to higher level health facility by a health staff for high-risk or complications or emergency (not for normal delivery). These referrals can be from primary to secondary or secondary to tertiary or primary to tertiary level health facility.

1.1.2 Based on reason for referral (Table 1) (14, 214)

i. Normal institutional delivery: Seeking care just for normal delivery without any high-risk or complication or emergency.

ii. Demographic high-risk: Demographic characteristics of mother that are predicted as high-risk for developing complications for mother or the baby.

iii. Obstetric high-risk: Characteristics in obstetric history of mother that are predicted as high-risk for developing complications in the mother or the baby.

iv. Obstetric early complications: Any medical complication that is developed or is complicated as a consequence of pregnancy during pregnancy, labour or child birth or after (within 42 days of termination of pregnancy). The woman may or may not require immediate transfer to higher facility.

v. Obstetric emergencies: Medical complications arising during pregnancy, delivery or post-delivery that may be life threatening for the mother or the baby. They require immediate transfer to higher facility if not managed at first facility. Any complication detected during delivery is also defined as obstetric emergency as it is to be managed immediately.

1.1.3 Based on urgency of transfer

i. Regular referrals: Referrals due to demographic or obstetric high-risk and complications that do not require urgent transfer to higher health institution. Regular referrals are decided during antenatal period for further antenatal check-up or for abortion or delivery or post-delivery care in higher facility for better management.

ii. Urgent referrals: Referrals due to early complications that require transfer within 3-4 days.

iii. Emergency referrals: Referrals due to an obstetric complications or emergencies that require immediate transfer to higher health institution.

1.1.4 Based on time of pregnancy when referrals done:

Referral during i. ante-natal period, or ii. Abortion, or iii. post-abortion, or iv. Delivery, or v) post-delivery. Referrals for elective induction of delivery, or during delivery or due to complications arising within 12 hours of delivery (during fourth stage of delivery) shall be defined as referrals for delivery.

Table 34: Classification of referral indications during pregnancy or delivery or post delivery

Type of complication	Examples
1. Demographic high-risk	1. Age of mother less than 20 2. First pregnancy at 35 or more years 3. 10 or more years since last pregnancy 4. ≥ 4 pregnancies
2. Obstetric high-risk	*History in previous pregnancy* 1. Caesarian section 2. Obstructed labour 3. Admission for hypertension or pre-eclampsia/eclampsia 4. Rh negative in the previous pregnancy 5. Stillbirth or neonatal loss 6. Three or more spontaneous consecutive abortions 7. Premature births, twins or multiple pregnancies 8. Weight of the previous baby <2500 g or >4500 g 9. Congenital anomaly *Current pregnancy* 10. Multiple foetus 11. Height < 150 cm 12. Spinal deformities, such as scoliosis/kyphosis/polio 13. Treatment for infertility 14. Heart disease, diabetes mellitus or tuberculosis
3. Obstetric early complication	1.Excessive vomiting (hyperemesis gravidarum)* 2. Bleeding per vaginum in <20 wks of pregnancy* 3. Malpresentation 4. High fever with or without abdominal pain (sepsis) 5. Haemoglobin 7-11 gm% even after consuming IFA tablets for 30 days (mild to moderate anaemia) 6.Haemoglobin < 7 gm% (severe anaemia)* 7. Gestational Hyper-thyroidism or diabetes 8. Hypertension with or without proteins in urine (pre-eclampsia) 9. Foul smelling discharge before or after delivery/ abortion (STI / sepsis) 10. Infections during pregnancy (Malaria, HIV, tuberculosis)*
4. Obstetric emergency	*Complications in delivery* 1.Preterm labour or Premature rupture of membranes (PROM) before 37weeks 2. Ruptured membranes for more than 18 hours 3. Active labour lasting longer than 12 hours in a primipara and more than 8 hours in a multipara (prolonged or obstructed labour) 4. Meconium or blood stained amniotic fluid 5. Perineal tear (2nd, 3rd and 4th degree) 6. Retained placenta or products of conception 7. Excessive bleeding during labour 8. FHR >160/minute or <120/minute 9. Decreased or absent fetal movements 10.Convulsion or loss of consciousness (seizure, eclampsia, shock) 11. High BP (>140/90 mmHg) with proteins in the urine, and severe headache with blurred vision or epigastric pain (severe pre-eclampsia) 12. Reduced urinary output with hypertension (renal failure, shock, DIC) 13.Ruptured uterus 14. Ectopic pregnancy *Complications anytime in pregnancy or post delivery* 8-14 and 15.Any bleeding per vaginum during pregnancy and post-delivery if a pad soaks in less than 5 min (ante- or post-partum haemorrhage) 16. Others (DIC, renal failure, injury, etc)

*depending on severity or time of detection, it may be classified as obstetric emergency

1.1.5 Based on quality of referral

i. Appropriate referrals: That are justified and not misdirected with adequate information to the patient and referral facility.

ii. Unjustified referrals: When client could have been managed at the referring facility and there was no medical need to refer.

iii. Misdirected referrals: When referral was justified but referred to a facility which does not have capacity to deal with the medical condition for which the client is referred.

iv. Inadequate referrals: Referrals with either incomplete information to the client or information passed to the receiving facility. Referrals without pre-referral stabilising care.

In low and middle income countries, institutional deliveries are widely promoted. Women visit any level of health centre for normal delivery even without any medical indication. Such movements to higher level are bypassing and to include them as part of referral system depends on national referral policy. These bypassers overburden the higher level of care and affect the quality of care. Overcrowding is a perceived barrier in seeking emergency care by others at these facilities. It is crucial to find ways to promote decision making for appropriate health facility and restrict overutilisation of secondary care for effective referral systems. One way of restricting overcrowding can be back referrals from higher facility to lower facility for normal deliveries.

1.2 Classification of level of health facility for referral pathways for obstetric care:

WHO proposed BEmOC and CEmOC centres with list of key signal functions that shall be performed at each level.(10) There are some centres managed by SBA which do not have the environment of the BEmOC.(8) Such centres are called delivery points/centres and deliveries in these is accepted as an institutional delivery. Apart from this, the centres/camps involved only in antenatal and postnatal care contribute in early detection of risks and complications, pre-hospital management and referrals.

Table 35: Signal functions performed at obstetric care centres (8, 115)

EmOC	Signal functions
Routine obstetric care Basic birthing centres	1. Antenatal care and screening 2. Monitoring and management of labour using partograph 3. Infection prevention measures 4. Active management of third stage of labour (AMSTL)
Basic Emergency Obstetric Care (BEmOC)	1. Administer parenteral antibiotics 2. Administer uterotonic drugs (ie. Parenteral oxytocin) 3. Administer parenetral anticonvulsants for pre-eclampsia and eclampsia (i.e. magnesium sulfate) 4. Manually remove placenta 5. Remove retained products (e.g. manual vacuum extraction, dilation curettage) 6. Perform assisted vaginal delivery (eg. Vacuum extraction, forceps delivery) 7. Perform basic neonatal resuscitation (eg with bag and mask)
Comprehensive Emergency Obstetric Care (CEmOC)	Performs all 1-7 functions of BEmOC and 8. Perform surgery (eg. Caesarian section) 9. Perform blood transfusion

Thus level of health facility defined in referral pathways for emergency obstetric care are:

i. Centres for Antenatal care: Sub health centres (SHC), health posts, dispensaries etc. These just provide antenatal services, education for birth-preparedness and complication readiness, and referral if complication arises.

ii. Basic birthing centres with Skilled Birth Attendant (SBA): SHC, Primary Health Centre (PHC) and Community Health Centre (CHC). There is also provision for antenatal screening and referral facility. Optimum (not essential) tests for antenatal screening are examination of weight, blood pressure, blood haemoglobin, urine sugar and proteins.

iii. Basic Emergency Obstetric Care (BEmOC) facility: Designated 24X7 Primary Health Centres and CHC. Not all the centres designated as BEmOC may have all the seven signal functions. Some may have 1 or 2 less functions. They may be referred as BEmOC -1 or BEmOC-2 depending on number of functions lacking in the designated facility.

iv. Comprehensive Emergency Obstetric Care (CEmOC) facility: Area / Sub-district hospitals, Maternity hospitals, District hospitals, Tertiary hospitals, and Medical colleges.

In remote areas, where there is no obstetric specialist care, Governments train ANMs, nurses and medical officers for skilled birth attendance to provide routine obstetric care at home or peripheral health centres. The difficulty of classification of level of emergency obstetric services pose problems in preparing and implementing referral guidelines; in assessment of availability and quality of EmOC care; and policy implications for emergency obstetric care. Due to similar reasons there is problem in accepting definitions of institutional delivery and quality of care in institutional deliveries.

Hierarchy of health institutions for general referrals in India (Based on level of health care)

i. Primary level (L1): Sub-heath Centre (SHC) and Primary Health Centre (PHC)
ii. First Referral Units (FRUs) (L2): Community Health Centre (CHC) , Area / Sub-district hospitals, Maternity Hospitals
iii. Second Referral Units (SRUs) (L3): District hospitals, Tertiary hospitals and Medical colleges

(Note: In Indian context L1 is equivalent to basic birthing centre or below; L2 to BEmOC; L3 to CEmOC. This is not yet widely adopted across the country.)

1.3 Factors contributing to delays in access to referral care

Table 36: Factors within referral systems contributing to delays in access to obstetric care

Factors contributing to delay	Phase of delay
Socio-economic / cultural factors -ethnicity, regional beliefs -marital status -family support -Women's education and autonomy Perceived need -recognition of high-risks and complications -perceived severity of risks and complications -perceived etiology -perceived benefits over cost -knowledge about appropriate health facility Perceived accessibility -distance -Transportation availability -cost for transportation, health care fees, other costs, -accompanying people Perceived quality of care at primary institution for preventive care -reputation / previous experience for satisfaction of treatment outcomes -24X7 services provided -fear of loss of control in hospital -Inter-institution transport facility Perceived quality of emergency care -reputation / previous experience for satisfaction of treatment outcomes -24X7services provided -fear of loss of control in hospital	Phase I- decision making for seeking care Preventive care seeking behaviour: self and community health worker referrals for high-risk and early complications or Emergency care seeking behaviour: self and community health worker referrals. *contributes to emergency preparedness
Quality of counselling for referral (for adherence to institution referrals)	Phase II- decision making to adhere to referral
Economic Accessibility - Ability to pay Physical Accessibility *Distribution and location of health facilities:* - rural / urban -in relation to level of care required - institution owned transport *Distance* - travel time - roads - outcomes in transit *Transport* - publicly available ambulance service - Community owned or arranged vehicles - institution owned transport for institution referrals *Costs for transportation* *Communication*	Preventive or emergency care seeking behaviour: decision to adhere to institution referrals Phase II: Identifying and reaching appropriate medical facility Preventive or emergency care seeking behaviour: any referral facility Adhere to institution referrals
Quality of preventive care and referral when complications arise Quality of institution referrals - referral guidelines - clinical judgment - referral counselling and advice - referral slips or communication to next level - arranging for transport vehicle.	
Equipped facility (staff, drugs, blood, other equipment) Management protocols and action Client friendly	Phase III: Receiving adequate and appropriate treatment

1.4 Transport used for referral transfers

i. Ambulance: Any motored or non-motored vehicle used for transportation of solely medical cases and that provides some en-route medical support.

1. Ambulance service owned by NGO / private / public sector: can be free or paid. The client or family or referrer needs to call it to the referring venue.
2. Ambulance service owned by the referring institution: can be free or paid and is available at the referring venue.

ii. Non-ambulance: Any motored or non-motored vehicle used for transportation of cases but does not provide en-route medical support.

1. Private or self-arranged: a vehicle owned or hired by the client (or family).
2. Arranged by community/ NGO: a vehicle owned or hired by community from common pool of funds / or paid by client.
3. Public transport: Vehicle as part of specific public / private sector intervention for medical transportation.

1.5 Maternal and Newborn outcomes and measures:

1.5.1 Maternal outcomes

i. Severe maternal morbidity or near miss: a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy.(215)

ii. Maternal mortality: The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. – ICD -10.

The group includes three categories: direct maternal deaths, indirect maternal deaths and unanticipated complications of management. Suicide in pregnancy, deaths from puerperal psychosis and postpartum depression are classified in the category of direct maternal deaths.(216)

iii. Maternal Mortality Ratio (MMR): The number of maternal deaths in a population divided by the number of live births. It depicts the risk of maternal death relative to the number of live births and essentially captures risk of maternal death per live birth.

iv. Maternal Mortality Rate (MMRate): The number of maternal deaths in a population divided by the number of women aged 15–49 years (or woman years lived at ages 15–49 years). The MMRate captures both the risk of maternal death per pregnancy or per birth (live birth or stillbirth) and the level of fertility in the population.

1.5.2 Fetal or Newborn outcomes

i. Stillbirth: Birth of a child with no signs of life at or after 28 weeks' gestation.

ii. Early neonatal mortality: Death of live born child within 7 days of birth

iii. Perinatal mortality: Stillbirths plus early neonatal deaths

iv. Early neonatal mortality rate (ENMR): The number of early neonatal deaths in a population divided by the number of live births.

v. Perinatal mortality rate (PNMR): The defined as number of peri-natal deaths in a population divided by the number of live plus stillbirths.

ANNEX II: PAPER 1: REFERRALS BETWEEN PUBLIC SECTOR HEALTH INSTITUTIONS FOR WOMEN WITH OBSTETRIC HIGH-RISK, COMPLICATION, OR EMERGENCY IN INDIA- A SYSTEMATIC REVIEW

London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
www.lshtm.ac.uk

Registry
T: +44(0)20 7299 4646
F: +44(0)20 7299 4656
E: registry@lshtm.ac.uk

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	SAMIKSHA SINGH
Principal Supervisor	PAT DOYLE
Thesis Title	REFERRAL SYSTEMS AND TRANSPORT FOR EMERGENCY OBSTETRIC CARE IN INDIA

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	PloS ONE 11(8): e0159793		
When was the work published?	2016		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	No		
Have you retained the copyright for the work?*	No	Was the work subject to academic peer review?	Yes

**If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.*

SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	Choose an item.

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I planned and conducted the research, and wrote the manuscript

Student Signature: [redacted] **Date:** 19 September 2017

Supervisor Signature: [redacted] **Date:** 19 September 2017

PLOS ONE

RESEARCH ARTICLE

Referrals between Public Sector Health Institutions for Women with Obstetric High Risk, Complications, or Emergencies in India – A Systematic Review

Samiksha Singh[1]*, Pat Doyle[2], Oona M. Campbell[3], Manu Mathew[4], G. V. S. Murthy[1]

1 Indian Institute of Public Health-Hyderabad, Public Health Foundation of India, Hyderabad, Telangana, India, **2** Department of Non-communicable disease Epidemiology, Faculty of EPH, London School of Hygiene and Tropical Medicine, London, United Kingdom, **3** Department of Infectious disease Epidemiology, Faculty of EPH, London School of Hygiene and Tropical Medicine, London, United Kingdom, **4** Medical Independent Consultant, Uttarakhand, India

* samiksha.singh@iiphh.org

OPEN ACCESS

Citation: Singh S, Doyle P, Campbell OM, Mathew M, Murthy GVS (2016) Referrals between Public Sector Health Institutions for Women with Obstetric High Risk, Complications, or Emergencies in India – A Systematic Review. PLoS ONE 11(8): e0159793. doi:10.1371/journal.pone.0159793

Editor: Yuan-Soon Ho, Taipei Medical University, TAIWAN

Received: September 12, 2015

Accepted: July 8, 2016

Published: August 3, 2016

Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Funding: This work was supported by a Wellcome Trust Capacity Strengthening Strategic Award to the Public Health Foundation of India and a consortium of UK universities. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have declared that no competing interests exist.

Abstract

Emergency obstetric care (EmOC) within primary health care systems requires a linked referral system to be effective in reducing maternal death. This systematic review aimed to summarize evidence on the proportion of referrals between institutions during pregnancy and delivery, and the factors affecting referrals, in India. We searched 6 electronic databases, reviewed four regional databases and repositories, and relevant program reports from India published between 1994 and 2013. All types of study or reports (except editorials, comments and letters) which reported on institution-referrals (out-referral or in-referral) for obstetric care were included. Results were synthesized on the proportion and the reasons for referral, and factors affecting referrals. Of the 11,346 articles identified by the search, we included 232 articles in the full text review and extracted data from 16 studies that met our inclusion criteria Of the 16, one was RCT, seven intervention cohort (without controls), six cross-sectional, and three qualitative studies. Bias and quality of studies were reported. Between 25% and 52% of all pregnancies were referred from Sub-centres for antenatal high-risk, 14% to 36% from nurse run delivery or basic EmOC centres for complications or emergencies, and 2 to 7% were referred from doctor run basic EmOC centres for specialist care at comprehensive EmOC centres. Problems identified with referrals from peripheral health centres included low skills and confidence of staff, reluctance to induce labour, confusion over the clinical criteria for referral, non-uniform standards of care at referral institutions, a tendency to by-pass middle level institutions, a lack of referral communication and supervision, and poor compliance. The high proportion of referrals from peripheral health centers reflects the lack of appropriate clinical guidelines, processes, and skills for obstetric care and referral in India. This, combined with inadequate referral communication and low compliance, is likely to contribute to gaps and delays in the provision of emergency obstetric care.

Background

Worldwide it is estimated that 287,000 women die due to maternal causes every year [1]. The majority of maternal deaths are due to direct obstetric causes [2]. Most obstetric complications, except those abortion-related, occur during delivery or immediately after delivery, and they have the potential to rapidly become life threatening [3]. To prevent maternal deaths, the complications occurring at home or birthing centres require timely and appropriate referral to basic emergency obstetric care (BEmOC) or specialist comprehensive emergency obstetric care (CEmOC), and referral from BEmOC to CEmOC [4,5,6,7]. A systematic review on interventions for improving maternal health observed that most successful programs focused on training for CEmOC, the placement and motivation of care providers, refurbishment of existing health institutions and establishment of referral and transportation systems [8].

An efficient referral system provides access to treatment and skills by linking different levels of care through appropriate referrals [9]. To refer a patient is a medical decision and depends on many things including the skills of the referring staff, the tools for diagnosis, the availability of a health institution with specialist facilities, the quality of care at the referral institution, the cost of care, distance, transportation, communication, someone to travel with the patient, and feasibility of travel by the patient [7]. The type of obstetric complication determines the level of care needed and the place to be referred to, and this makes the referral pathways complex [7,10]. Compliance to referral may depend on the counselling skills of the referrer, the socio-cultural beliefs of the patient and her family, and perceptions of the quality of care [7]. A recent systematic review on interventions to improve referral systems and transportation for EmOC in developed country settings observed that most programs focus on birth preparedness, complication readiness, availability of transport, and costs of transport [10]. The interventions included in the review focused on improving self-referrals, with only a few on interventions to improve referrals between institutions, the number and quality of institution-referrals, and transport for between-institution transfers.

India accounts for a fifth of annual global maternal deaths (56,000) [1] and the Maternal Mortality Ratio (MMR) is estimated to be 167/100,000 live births (Sample Registration System, SRS-2011-13) [11]. India has implemented many interventions to reduce the MMR, including schemes to strengthen health infrastructure and to improve the proportion of institutional deliveries [12]. There is some evidence that these schemes increased institutional deliveries [13,14] but a corresponding reduction in the MMR was not achieved [15–17]. Maternal death reviews from India suggest that most of the mothers who died had gone through multiple referrals before reaching the appropriate facility [18–20].

A preliminary review of Indian health policy, Reproductive Health Program documents and interview with state maternal health consultants, by reviewers, revealed that there are no standard procedures or referral protocols for obstetric emergencies and complications in India. SBA training manuals mention clinical criteria for referral but these guidelines are not supported by appropriate resources in the health system. Usually no records relating to referrals between institutions are kept and no referral slips or communication about the referred case is provided to the next level institution [21]. There is no routine feedback mechanism or routine monitoring of the appropriateness of referrals in India [21].

Rationale for Systematic review

There is a paucity of evidence from India on the proportion of complicated and emergency obstetric cases that are detected at the primary health institution level and referred to appropriate higher level health institutions. This systematic review from India will help understand the existing referral criteria, referral pathways, factors affecting referrals and proportion of referrals

for obstetric care across the country. With changing policies and interventions to strengthen EmOC it is necessary to understand the changes in referral systems over time and existing needs in India.

Research Question

What is the proportion of referrals between public health institutions for women with obstetric high risk, complications, or emergencies in India?

Secondary question. What are the socio-economic and medical characteristics of women who are referred for obstetric causes and what are the referral pathways utilized?

Methods

The research obtained ethics approval from ethics committees of both LSHTM and IIPH-Hyderabad. (LSHTM Ethics Ref: 9613; IIPHH Ethics Ref: IIPHH/TRC/IEC/009/2014)

Summary of the health care system in India

The Subcentre (SC) is the most peripheral unit in the existing government health care system in rural India and is the first level of contact where antenatal care is provided (Fig 1). In a few states deliveries are also conducted at SCs by a trained Auxillary nurse midwife (ANM)/ Health worker (Female) or nurse. Primary health centres (PHCs), the next level, have been proposed as 24X7 BEmOCs but many just work as delivery centres and a few do not even provide delivery services. Community health centres (CHCs) are where an obstetrician may be present and a CHC may work as a BEmOC or a CEmOC. First referral units (FRUs) are upgraded CHCs, Sub-district hospitals, District hospitals and specialist hospitals able to provide CEmOC care

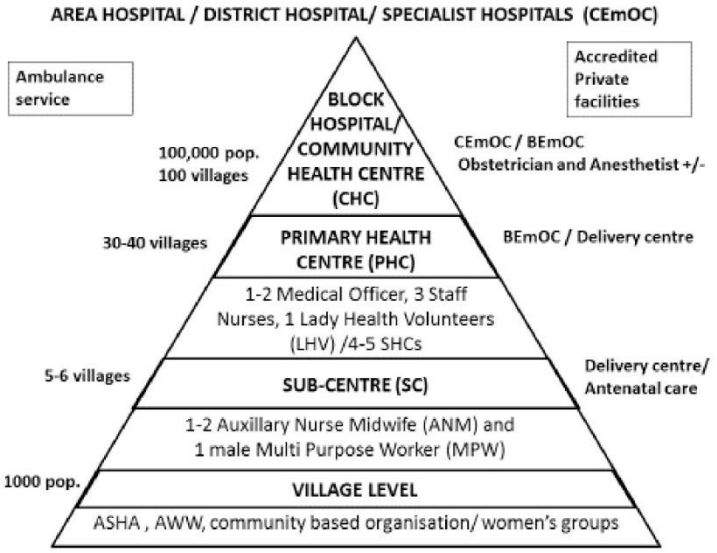


Fig 1. Rural public health system for obstetric care in India.

doi:10.1371/journal.pone.0159793.g001

[22]. Pregnant women can choose to go directly to any of these centres, by-passing the hierarchy. In case of referral they can choose to comply with referral advice or go elsewhere.

In urban areas, there are dispensaries, urban health centres and urban health posts which provide antenatal care and referral. A few of the urban health centres have been upgraded as delivery centres. At the next level are Maternity hospitals (BEmOC) and secondary and tertiary care hospitals (BEmOC/CEmOC) [23]. There are several medical colleges and other hospitals that provide specialised care. These are mostly located in urban areas and cater to the referral needs of both rural and urban populations.

Working Definitions

An institution-referral is when a client seeks care at a lower level health institution (delivery centre or BEmOC) and is referred onwards to a higher level institution (BEmOC or CEmOC) by health staff for specialist attention. The referral is made for reasons of a high risk pregnancy, complications during pregnancy and puerperium, or an emergency at any time in pregnancy and puerperium.

Search Strategy

The literature search was conducted using six mainstream databases (Medline, Embase, Popline, IMSEAR, Cochrane Central Register of Controlled Trials (CENTRAL) and CINAHL) and four other databases (WHO, UNICEF, UNFPA and Indian RCH repository). Grey literature sources, such as program reports, were also used. The review was restricted to studies from India, published in English between 1994 and 2013.

The electronic search strategy was based on terms related to referral or emergency, and pregnancy, obstetric high risk, obstetric complications, or obstetric emergencies, and India. Appropriate MeSH and/or keywords using respective thesauri were used in the search strategy as mentioned in S1 Text.

Inclusion criteria.

1. All studies (hospital or community based) and reports with institution-referrals for obstetric care, with any kind of epidemiological study design, were included. Studies reporting either in-referrals from lower-level institution or out-referrals to higher-level institution were included.
2. Type of participants in the studies or reports: Studies with pregnant, post-abortion and post-partum women referred by staff from designated public health institutions to a higher level referral institution were included.
3. Place of study: India

Exclusion criteria.

1. Studies or reports on referrals for non-maternal conditions.
2. Editorials, commentaries and letters.

Screening

Screening was done by two independent researchers using the inclusion and exclusion criteria. Screening was first done based on titles and abstracts and then subsequently by reading full text. Disagreement between reviewers, was resolved by discussion and establishing consensus.

Data Collection

Measurement indicators studied were: the proportion of in-referrals and out-referrals; cause-specific referrals; place from where referred and the place referred to; pre-hospital treatment; availability and arrangements for transportation; type of transport and communication; costs and cash incentives; and compliance rates, and socio-economic and medical characteristics of women referred. Data extraction forms were developed and piloted before use. Information was extracted on the type of intervention, if any, and the prevalence of outcomes and costs were considered. Key qualitative findings were also recorded and described.

The quality of papers was assessed using STROBE guidelines for observational studies and CONSORT guidelines for intervention studies. A score of 1 was assigned to each item in the checklist and a total score was calculated for each paper (maximum score- STROBE = 22; CONSORT = 25). A score below 11 out of 22 for observational studies, and below 13 out of 25 for intervention studies, indicated poor quality. Potential risk of bias in methods (selection, performance and detection), analysis and reporting were assessed for each of the studies with respect to study designs. Reviewers also discussed the limitations in combining the results from different studies in the review.

Synthesis of results

Both quantitative and qualitative research studies were included. Each selected study was assessed with respect to the type of study and measurement indicators (proportions). Findings were summarized separately for a) abortion and post-abortion care, b) antenatal high-risk and c) complications and emergencies any time during pregnancy and the puerperium. Qualitative studies were reviewed to provide supplementary information regarding institution-referral rates, pathways and barriers to appropriate referral. The review was reported in line with the PRISMA checklist as reported in S1 PRISMA Checklist.

Results

Search results

The search yielded 11,346 articles from electronic searches and other sources (program or project reports from specified organisational repositories) (Fig 2). Duplicates (2,188) were removed before screening. A total of 9,158 articles and reports were screened for eligibility, of which 8,174 were excluded based on titles alone and 752 based on titles and abstracts. Reasons for exclusion were mainly that the studies were not from India, were not about pregnant women or pregnancy, or were editorials. A total of 232 articles and reports were selected and full texts were read to assess for inclusion. Of these, 215 articles were excluded because they did not mention institution-referral pathways or proportions of institution-referrals. Finally, three qualitative articles and fifteen quantitative research articles were found eligible for inclusion [24–41]. Of these, two articles were from the same study: one was a study protocol [40] whose subsequent article on results [32] was included for quantitative analysis. One article was further excluded at the time of data extraction [41]. Although this article mentioned admissions in hospital as referrals, it could not be concluded if those were referrals from other institutions. During the synthesis of results and reviewing new literature, researchers found one paper very relevant to the review but it was published in 2014 i.e. later than the search criteria of up to 2013 [36]. It was decided to include this paper in the results.

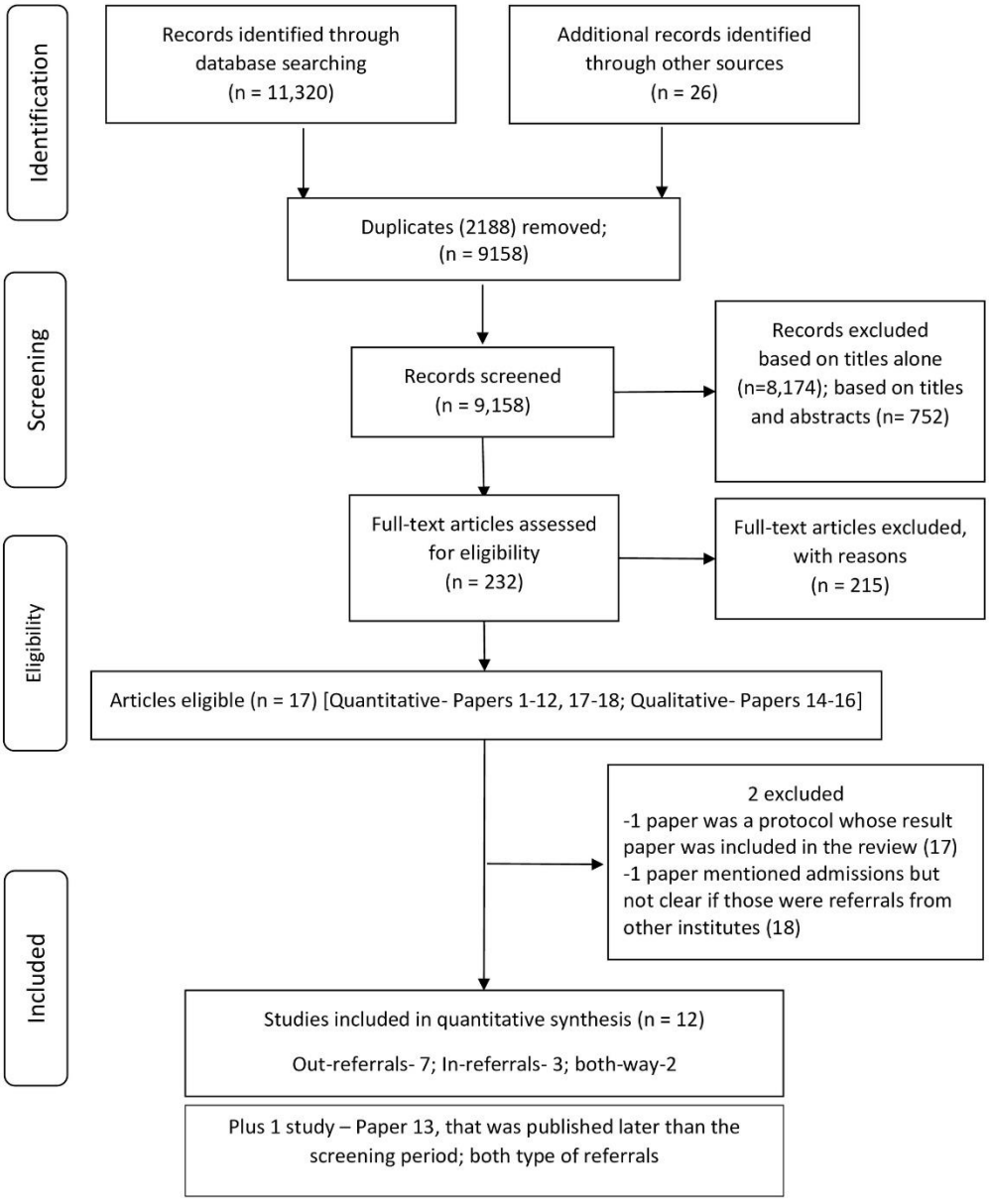


Fig 2. PRISMA Flow Diagram for Systematic Review.

doi:10.1371/journal.pone.0159793.g002

Characteristics of included studies

Quantitative. Out of the thirteen studies, out-referrals from a health institution was documented in 7 (papers 1–3, 6–9, Table 1), in-referrals to a health institution in 3 (papers 10–12, Table 1) and both out-referrals from and in-referrals to a health institution were documented in 3 studies (papers 4, 5, 13, Table 1). Among the 7 out-referral studies, five were prospective cohort studies following an intervention (without controls), one was a cluster randomised trial, and one a cross-sectional study. Two of the three studies that mentioned both-way referrals were prospective cohort studies following interventions and one was a cross-sectional study. All 3 in-referral studies were cross-sectional studies. One of these cross-sectional studies was only about abortions [35]. Characteristics of the studies are described in Table 1.

Qualitative. Of the three studies (papers 14–16, Table 1), one conducted in-depth reviews and focus group discussions and the other two conducted only in-depth interviews among the pregnant women and/or care takers. One study was only about abortions (paper 14, Table 1). These studies were not scored on quality. However potential biases were identified.

Interventions. Five out of eight studies involving interventions focused on improving high risk identification during antenatal care (ANC) and referral by a medical officer (MO), ANMs, Village health volunteers (VHWs) or traditional birth attendants (TBAs) (papers 1–4 and 8, Table 1). Three studies also trained the ANMs, VHWs and TBAs for conducting safe deliveries, identification of complications and referrals (papers 3, 8 and 9, Table 1). In two studies MOs were trained for supervision of ANMs and VHWs. Only two studies focused on improving EmOC at primary level health institutions and referral to a higher level (papers 5 and 7, Table 1). However it should be noted that the institutions in these studies were primarily run by trained nurses and had an on-call medical officer or obstetrician available for opinion. In one study (paper 13, Table 1) a cash incentive transfer scheme, the Janani Suraksha Yojana (JSY) [42], implemented by the government covered the availability and cost aspects of referral transport. The state government where this study was based also had Janani Express Yojana [43], a system that transported pregnant women to health institutions.

Quality of included articles. Table 2 provides the scores of individual studies and summarises the potential biases as assessed by the reviewers. One paper (paper 1, Table 1) was found to be of poor quality. Although most of the studies intended to improve or report referrals, they did not report results completely. It was difficult to ascertain if the referrals were due to high-risk or complications.

Out-referrals

Table 3 summarizes the findings on out-referrals. The relevant articles are discussed below.

Referrals for abortion and post-abortion care. No article found.

Referrals for high-risk pregnancy. Three articles exclusively report on high-risk screening in pregnancy and out-referrals by community health staff or staff within a Subcentre [24,27,31]. All the three studies involved training ANMs for high-risk identification and referral to a higher level (PHC or Public Rural Hospital). The other 6 studies on out-referrals report on both high-risk cases and complications in pregnancy [25,26,28–30,32]. However these did not report the proportion referred for high risk in pregnancy. These are covered in the next section on complications in pregnancy.

Proportion of out-referrals: Maitra [24] reported that 4,522(35%) pregnancies in rural areas of 6 states were identified as being at high risk out of the total registered pregnancies (12,907). Only 786(17.6%) of the high risk pregnancies (i.e. 6% of all the pregnancies) were referred after intervention. However this paper scored poor on quality. Barua [27] also reported that after intervention, Subcentre ANMs found 35%-37% of registered pregnancies in rural

Table 1. Characteristics of studies included in the review.

SNo	Author	Type of study	Time of study	State	Rural/ Urban	Type of institutions	Participants (N0.s)	Intervention
Out-referrals								
1	Maitra 1995 [24]	Intervention-Prospective Cohort[b]	1987–1990	Uttar Pradesh, Madhya Pradesh, Haryana, Rajasthan, Gujarat, Maharashtra	Rural	SC and PHC	Antenatal women registered at SC or PHC (12,907)	Training of community for high-risk; Training of ANMs and MO for ANC, high-risk screening, referral and record keeping for referrals
2	Hitesh 1996 [25]	Intervention–Prospective Cohort[b]	1993	Rajasthan	Rural	SC	Antenatal women in community (206)	Training of ANMs and TBAs for ANC, high risk screening and referral. Red referral card was issued to refer women.
3	McCord 2001 [26]	Intervention–Prospective Cohort[b]	1996–1999	Maharashtra	Rural	Community and Private hospital	Antenatal women and women in labour in the community (2,905 pregnancies)	Training of community via VHWs; Training of VHWs for ANC, high risk screening, delivery care, complication identification and referral; low cost delivery and referral care at private hospital
4	Barua 2003[a] [27]	Intervention–Prospective Cohort[b]	1994–2001	Maharashtra	Rural	Community and PHC	Antenatal and postnatal women attending clinics (NA)	Training of ANMs for ANC, high risk screening and referral to PHC, establishing ANC clinics to be run by ANMs, MOs of PHC trained for supervision and referral to DH.
5	Iyengar 2009[a][28]	Intervention–Prospective Cohort[b]	2000–2008	Rajasthan	Rural	Equivalent to PHC run by NGO midwife / nurse	Antenatal, intra-natal and postnatal women attending at the health institution (2,771 deliveries + 400 in-referred complications)	Training of nurse midwifes at health institution for ANC, EmOC and referral in consultation with on-call obstetrician
6	More 2010 [29]	Cross-sectional	2005–2007	Maharashtra	Urban slums	Community	Pregnant women who delivered in the community (10,754)	-
7	David 2012 [30]	Intervention-Retrospective Cohort[b]	2005–2010	Tamil Nadu	Urban	UHC	Antenatal, intra-natal and post-natal women at the health institution (1,873 deliveries)	Training of 2 nurses at UHC for ANC, EmOC and referral in consultation with on-call family physician
8	Alehagen 2012 [31]	Intervention-Prospective Cohort[b]	2006–2009	Maharashtra	Rural	Community, SC and PHC	Antenatal women and women in labour in the community (31,693 deliveries)	Training of community for high risk & complication via female health volunteers; Training of ANMs and TBAs for ANC, high risk screening and referral; Training of ANMs and TBAs for safe delivery at home or PHC, complication identification and referral; Training of Nurses and MO at PHC for supervision. Establishing 9 PHCs and 5 mobile clinics.

(*Continued*)

Table 1. (*Continued*)

SNo	Author	Type of study	Time of study	State	Rural/ Urban	Type of institutions	Participants (N0.s)	Intervention
9	Pasha 2013 [32]	Cluster RCT	2009–2011	Maharashtra, Karnataka	Rural	Community, PHCs and referral hospitals	Antenatal women and women in labour in the community (20,852 deliveries in Intervention; 18,551 in control)	Training of community via community facilitators for high risk, complication and birth preparedness; Training of community birth attendants (TBAs and ANMs) for home based life-saving skills and referral; Training of staff at health institution for EmOC facility improvement.
In-referrals								
10	Biswas 2004 [33]	Cross-sectional	1997–1998	West Bengal	Rural and Urban	First Referral units(FRUs)—Area and Rural hospitals	Pregnant women admitted for delivery (26,062)	-
11	Kaul 2006 [34]	Cross-sectional	2000–2003	Chandigarh	Rural and Urban	Tertiary hospital	Postnatal women who developed PPH at the hospital or admitted with PPH after delivery (178)	-
12	Banerjee 2012[c] [35]	Cross-sectional	2006	Madhya Pradesh	Rural and Urban	Secondary and Tertiary Hospital	Women seeking care for post abortion complications (786)	-
13	Chaturvedi2014[a] [36]	Cross-sectional	2014	Madhya Pradesh	Rural and Urban	Secondary and Tertiary Hospital	Women seeking care for intra-natal care (1182)	Government of India managed Janani Suraksha Yogana which provides cash incentives to women delivering in institutions. Part of this incentive covers cash for transfers. Government of Madhya Pradesh also instituted Janani Express to provide vehicles for transfer of pregnant women to health institutions.
Qualitative								
14	Johnston 2003 [37]	Focus group discussions and In-depth interview	1999	Uttar Pradesh	Rural	Community	Men and women, women in reproductive age, post-abortion care providers	-
15	George 2007 [38]	In-depth interview	2004	Karnataka	Rural	Community	Pregnant women seeking delivery care	-
16	Vijayshree 2012 [39]	In-depth interview	2011	Karnataka	Rural	Not mentioned	Women seeking delivery care	-

[a]Both out and in- referrals

[b]No controls

[c]Abortions only

SC = Sub–Centre; PHC = Primary Health Centre; UHC = Urban Health Centre; ANC = Antenatal care; MO = Medical officer; ANM = Auxillary nurse midwife; VHW = Village health volunteer; TBA = Traditional birth attendant

doi:10.1371/journal.pone.0159793.t001

Table 2. Quality scores (based on Strobe and Cochrane guidelines) and potential biases.

SNo	Author	Type of study	Scores based on STROBE/ CONSORT	Potential bias [a]
Out-referrals				
1	Maitra 1995 [24]	Intervention- Prospective Cohort[b]	10/ 22 Poor quality	• Difficult to ascertain bias as the methods were not properly described. Results about timing and reasons for referral were also not clearly mentioned.
2	Hitesh 1996 [25]	Intervention–Prospective Cohort[b]	15/ 22 Medium quality	• Reporting bias: The details about when (during antenatal, intra-natal or post-natal period) the pregnant women were referred were not provided. Difficult to differentiate between referrals for high-risk or complications.
3	McCord 2001 [26]	Intervention–Prospective Cohort[b]	20/ 22 High quality	-
4	Barua 2003 [27]	Intervention–Prospective Cohort[b]	15/ 22 Medium quality	• Difficult to ascertain bias. Methods for baseline survey and facility survey not elaborated. Methods of surveillance and record keeping not mentioned.
5	Iyengar 2009 [28]	Intervention–Prospective Cohort[b]	19/ 22 High quality	• Reporting bias: The details (outcomes or referral) of the cases managed by the visiting obstetrician were not mentioned. Overall referral rates for the institution may be different.
6	More 2010 [29]	Cross-sectional (Study is a baseline before a trial.)	19/ 22 High quality	• Performance bias: Data collection was spread over two years during which some interventions had started. This could have led to contamination and influenced the outcomes. • Reporting bias: The details about when (during antenatal, intra-natal or post-natal period) the pregnant women experienced the reported complaints and were referred were not provided. Place of birth and pregnancy outcomes not mentioned. • Detection bias: Symptoms that are unrecognised, not thought to be serious or considered normal may lead to under reporting and limited care-seeking
7	David 2012 [30]	Intervention- Retrospective Cohort[b]	17/ 22 Medium quality	• Reporting bias: High risk pregnancies identified during ANC were referred to higher level health care and their deliveries were not attempted at the institution. The paper doesn't report these numbers.
8	Alehagen 2012 [31]	Intervention–Prospective Cohort[b]	15/ 22 Medium quality	• Study was not planned as pre-post intervention study. • Difficult to ascertain bias as the methods of data collection are not elaborated. The baseline was assessed by a survey while the follow up data collection/ recording and frequency of recording is not described.
9	Pasha 2013 [32]	Cluster RCT[c]	20/ 25 High quality	• Performance bias: Intervention could not be completely implemented. • Blinding could not be done. • Reporting bias: Referral related process indicators were not reported.
In-referrals				
10	Biswas 2004 [33]	Cross-sectional	18/ 22 High quality	• Detection bias: The data were extracted from hospital records of past years. The quality of recording and diagnostic criteria may have varied over time. • Reporting bias: Reference period was not mentioned thus it was difficult to assess referral rates over time.
11	Kaul 2006 [34]	Cross-sectional	17/ 22 Medium quality	• Detection bias: The data was extracted from hospital records of past 4 years. The diagnostic criteria of post-partum haemorrhage for deliveries in the study hospital may vary from the referred cases whose deliveries were outside the study hospital. The later cases were also by selection more likely to be in moribund state due to time lost in travel and seeking care.
12	Banerjee 2012 [35]	Cross-sectional	19/ 22 High quality	• Detection bias: Symptoms of complications of abortions were self-reported and may vary in perception of relevance and seriousness.
13	Chaturvedi 2014 [36]	Cross-sectional	20/22 High quality	• Performance bias: Data collection was spread over one year but only 5 days in each of the 96 institutions. Five days of recruitment is a short period to comment on functioning and referral of an institution. Institution may try to perform better during the study period. • Reporting bias: The health institution were referred as primary, secondary and tertiary. It was not clear if primary level institutions were just delivery centres or BEmOC. Similarly, were the secondary level institutions providing all BEmOC functions or were CEmOC? This makes it difficult to assess the referral quality in review of obstetric emergencies.

(*Continued*)

Table 2. (*Continued*)

SNo	Author	Type of study	Scores based on STROBE/ CONSORT	Potential bias [a]
Qualitative				
14	Johnston 2003 [37]	FGDs and In-depth interview	-	-
15	George 2007 [38]	In-depth interview	-	• Not planned as a scientific study. During a big study, 12 women seeking emergency obstetric care were impromptu followed and interviewed.
16	Vijayshree 2012 [39]	In-depth interview	-	• Difficult to ascertain bias. Source of sample and detail methods of data collection and analysis not mentioned.

[a]Taxonomy based on risk of Bias from Cochrane Handbook

[b]No controls

[c]Consort

doi:10.1371/journal.pone.0159793.t002

areas in Maharashtra at high-risk and they referred them all to PHC medical officers. When anaemia and short-stature were excluded from these referrals then referrals to the PHC medical officer were only 18%. Alehgen [31] reported an increase from 25% cases identified and referred for high risk in 2006 to 52% in 2009 out of an estimated population of approximately 7,000 deliveries in a year in rural areas of Maharashtra.

In the Maitra and Barua studies, medical officers within the PHC further referred critical high-risk cases elsewhere for delivery (numbers and type of severity not reported) [24,27].

Medical reasons for referrals: Pre-eclampsia was detected in 11% and severe anaemia in 8% of all pregnant women in the study by Alehgen in 2012 [31].

Table 3. Summary findings of institution out-referrals for abortion, high-risk pregnancy, or complications in pregnancy/delivery.

Out-referrals for reasons:	Percentage of cases identified out of all pregnancies	Percentage of all pregnancies referred	Percentage compliance out of all referred	Second referral to higher institution
Abortion*	-	-	-	-
Antenatal high-risk				
Subcentre/ community to PHC/ other institution				
Maitra, 1995 [24]	**35%**	**6%**	**52.9%**	
Barua, 2003 [27]	35%-37%	35%-37%	-	
Aleghan, 2012 [31]	25%-52%	25%-52%	-	
Complication or Emergency				
Subcentre/ community to PHC/ other institution (BEmOC or CEmOC)				
Hitesh, 1996 [25]	-	-	**10.2%**	
Mc Cord, 2001 [26]	-	-	-	**4.7%**
Pasha, 2013 [32]	-	-	-	-
Nurse run health centre or PHC (BEmOC) to First referral unit (FRU)/ CEmOC				
Iyengar, 2009 [28] (All pregnancies in any phase of pregnancy)	**26.1%**	**19.7%**	**67%**	-
David, 2012 [30] (Low risk pregnancies for delivery care)	**36.3%**	**36.3%**	**68.6%**	-
Chaturvedi,2014 [36]		**14.3%**		
Doctor run health centre (BEmOC) to higher institution (CEmOC)				
More, 2011 [29]	-	**2%**	-	-
Chaturvedi, 2014 [36]		**7.5%**		

*cases of spontaneous abortions and post-induced abortion complication would have presented as complications in pregnancy

doi:10.1371/journal.pone.0159793.t003

Institution-referral pathway and compliance: During the baseline survey, Maitra, 1995 [24] and Barua, 2003 [27] noted that there were no referral records and no mechanisms whatsoever for identifying high-risk pregnancies before the intervention was implemented. These articles do not mention the type and quality of referral records that were maintained during the intervention.

Alehgen, 2012 [31] realized that the limited skills of available nurses and medical officers, and the high turn-over of staff, were limitations in establishing nurse-based ANC care. The study at baseline found that ANMs lacked equipment, skills and confidence to screen for high-risk, provide treatment, and refer appropriately. Similarly PHC medical officers lacked the skills and confidence to manage high-risk cases. As part of the intervention Subcentre ANMs and PHC medical officers were trained for their respective roles. Referrals were to be made to the next level of available public health institution. However there was no reporting of results, including whether any pregnant women were referred to a private health institution or if they complied with the choice of suggested referral institution. It is interesting to note that between 1995 and 2012 there was little improvement in high risk screening and referral [24,27,31].

In the study by Maitra in 1995, [24] most of the referrals made by the field workers were to a Subcentre. About half (52.9%) the women with high risk complied with referral.

Referrals for complications or emergency in pregnancy or puerperium. Six articles reported out-referrals for complications in pregnancy [25,26,28–30,32]. Two qualitative articles provide patient experiences of referrals for complications [38,39].

Proportion of out-referrals: Community health staff/ Subcentre to PHC/ BEmOC: In three studies [25,26,32] the intervention involved strengthening the skills of ANMs, TBAs or their equivalent in the community for ANC care, delivery care and referral. One of these studies [32] also provided training for home based life-saving skills to stabilise patients before referral. None of these studies report the proportion of high-risk or complication cases referred by these nurses to health institution.

Nurse run health centre (equivalent to PHC) / BEmOC to first referral unit (FRU) / CEmOC: One study in a rural area in Rajasthan by Iyengar, 2009 [28] and another in urban slums in Tamilnadu by David, 2012 [30] attempted to strengthen the skills of nurses at the health centres (equivalent to Primary health centre) to provide BEmOC services and referral under the mentorship of a visiting obstetrician [28] or physician [30]. The nurses in both studies did not induce labour in the absence of a doctor. In the first study 2,771 women presented in labour of whom 446(16.1%) were referred to FRU [28]. The second study based in urban slums referred all the high risk pregnancies to the next level of care and only attempted to assist 1,873 low risk pregnancies during the study period. Of these, 679(36.3%) were referred to a higher level for delivery and one post-partum hemorrhage case (out of 7) for treatment.

Mc-Cord in 2001 [26] reported that 20(4.7%) of 425 pregnant women from a rural study population in Maharashtra who attended the FRU were referred further onward for advanced specialist care. A study in urban slums in Maharashtra in 2011 [29] reported that less than 2% clients who sought care for any high-risk or complications at either public or private providers were referred to another health institution. The study also reports that as this urban population had access to range of health institutions, the community itself took efficient decisions on where to go based on their perceived severity of the symptoms and thus they may not have required further institution-referral.

Chaturvedi in 2014 [36] studied all the levels of health institutions which were assisting at least 10 deliveries in a month in 3 districts of Madhya Pradesh. Except PHCs, all other institutions had 24X7 medical officers available. The study reported that 5.9% of 1182 women seeking delivery care were referred out. The out-referral rate was highest from PHCs(14.3%) followed

by CHCs(7.5%) and tertiary hospitals(0.8%). Half of the referrals from PHC were directly to tertiary hospitals, bypassing the CHCs.

Medical reasons for referrals: Among all the deliveries attempted or complications occurring at a nurse based rural health centre in Rajasthan, common reasons for referral were obstructed labour(25.1%), antepartum haemorrhage(16.2%), pregnancy induced hypertension (15.7%), severe anaemia(13.8%), complicated abortion(12.0%), post-partum haemorrhage (6.0%) and twin pregnancy(5.5%) [25]. Among low risk deliveries conducted at the nurse-based urban health centre, common reasons for referral were premature rupture of membranes (20%), failure to progress(15%), foetal distress (8.8%), pregnancy induced hypertension(10%), post-date pregnancies(6.2%) and grade-III meconium(6.3%) in early labour [30].

About two-fifths of the referrals from PHCs(43.1%) and three-fifths from CHCs (58.5%) in Madhya Pradesh were for prolonged labour and premature rupture of membranes followed by haemorrhage(10.3% in PHC and 6.6% in CHC) and eclampsia(3.4% in PHC and 6.6% in CHC). It is interesting to note that about 7% of referrals were due to facility dysfunction i.e. non-availability of staff, power or water [36].

Institution-referral pathway and compliance: In a 1996 study investigating the role of training, Hitesh reported that 206 women were issued a red referral card for high-risk or complications in 12 Subcentres [25]. Of these, only 21(10.2%) made any attempt to go to next level of health care. In the study in urban slums by David in 2012, 68.6% of referred women complied with referral [30], while in the study in rural areas by Iyengar in 2009, 74% of referred women complied [28]. Both the studies provided accompanying persons when required. Providers in the later study also arranged for transportation. Fixed rate private jeeps were available for transfer and for poor patients, nurses arranged transport for free or for subsidized rates.

Hitesh found that the most common (overlapping) reasons mentioned for non-compliance were cost(100%), lack of follow-up after reaching the institution(92.4%), TBA advised against it(92.4%), non-availability of transport(79.4%), previous bad experience(74.6%) and patients considering their symptoms normal(61.1%) [25]. Iyengar found that compliance was higher when complications occurred before the baby was born (78.7%), compared to those that occurred after delivery or abortion (57.1%) [28]. Patients with ante-partum haemorrhage and severe anaemia were difficult to convince about their need for referral. They tended to be apprehensive that relatives would be asked to donate blood [28].

Qualitative studies. The study by George et al in 2007 [38] reported case studies of 12 rural pregnant women in Karnataka who were seeking care for complications in pregnancy. These case studies highlighted that despite repeated visits to the public and private health care providers, patients did not obtain the required emergency obstetric care. The main reason identified was poor service delivery. The health systems had weak information systems, there was no continuity of care from antenatal to delivery and postpartum, peripheral health workers were unsupported and did not have the required skills, and there were haphazard referral systems and distorted accountability mechanisms when adverse events occurred [38]. Nine of the twelve women under study died despite seeking care in time.

Another study in Karnataka in 2012 of 10 users of EmOC services showed that these pregnant women received appropriate antenatal care but were not confident of where and when to get the EmOC services [39]. The designated FRU's (CEmOC) had not been able to ensure 24 hour services every day of the week. All these women were living below the poverty line and belonged to scheduled castes or tribes. The six pregnant women with bad outcomes had gone through several referrals both in public and private health institutions. This was mostly due to non-availability of resources at the time of their visit. There was a time lapse of 10 hours to 32 hours to receive the required level of EmOC and there was a tendency to refer women at high-risk, or with complications, for the fear of facing maternal death audits and blame. The four

women who had good outcomes received EmOC care due to interventions of caste-based organisations, local practitioners or concerned unions [39].

In-referrals

Referrals for abortion and post-abortion care. Only one paper on in-referrals by Banarjee, 2012 [35] reported on referral related to abortion and complications of abortions.

Proportion of in-referrals: A total of 381 cases with complications after induced abortion and 405 after spontaneous abortion were interviewed. Eighty eight percent of the induced abortion group and 19.6% of the spontaneous abortion group had visited at least one institution before coming to the study hospitals [35].

Among the induced abortion group, 27(7%) came directly to the study hospitals for inducing an abortion, 10(5%) tried induction of abortion at home then came directly, 273(72%) visited one health institution, 59(12%) visited 2 institutions and 12(3%) visited 3 institutions before coming to one of the study hospitals. Among the spontaneous abortion group 327 (80.4%) came directly to study hospitals and the rest 78(19.6%) visited one health institution before coming to the study hospitals.

Medical reasons for referrals: The paper mentions the self-reported symptoms but nothing about specific reasons for institution-referral.

Institution-referral pathway and compliance: Most of the women were not aware if the health providers they visited were qualified or not [35]. A qualitative paper by Johnston, 2003 [37] interviewing post-abortion care providers in study villages in rural Uttar Pradesh revealed that pregnant women consulted the local village-level providers for abortion care rather than going to the nearest health institution. Village-level providers were all un-qualified practitioners, however the pregnant women thought they were qualified. These village-level providers tended to provide abortion and post-abortion care rather than refer to more appropriate providers. If the case was critical they would refer the case to the nearest town, however no specific health institution was mentioned.

Referrals for High-risk in pregnancy. No article found.

Referrals for complications or emergency in pregnancy or puerperium. Three articles reported in-referrals for complications in pregnancy [33,34,36].

Proportion of in-referrals: Biswas in 2004[30] reported that on an average 5–10% of all in-patients at FRUs in West Bengal were in-referrals from peripheral health institutions (estimate as told by the head of institutions). In a tertiary hospital in Haryana, Kaul in 2006 [34] reported that 90(0.6%) of 13,907 deliveries developed post-partum hamorrhage and another 88 PPH cases were referred in after having delivered elsewhere. Nineteen women(10.7%) suffered "near-miss" morbidity (5 in hospital delivery and 14 referred cases).

Chaturvedi in 2014 [36] found that 111(9.4%) of 1,182 women seeking delivery care were referred in from other institutions. None of the cases referred in by other institutions required to be referred out again. The proportion of in-referrals was highest in government tertiary institutions(21.2%) followed by private hospitals(16.1%), both of which were working as CEmOCs. CHCs which were working as BEmOCs received only 1.6% in-referrals. It is important to note that the average number of women in labour per institution was 121 for tertiary institutions, 21 for CHCs, 6 for private hospitals and 4 for PHCs over a five day period [36].

Medical reasons for referrals: Not specified.

Institution-referral pathway and compliance: Kaul found that 54(61.3%) of 88 referred PPH cases were transferred in more than 6 hours after delivery elsewhere. All 14 near-miss cases in the referred group reached the tertiary hospital more than 6 hours following delivery [34]. In Madhya Pradesh, 63% in-referrals used a Janani Express vehicle. The average inter-

institution travel time was 1.25 hours [36]. About three-quarters (72%) in-referred cases had a referral slip however they mostly did not contain the reasons for referral and the treatment provided before referral [36]. The superintendents of FRUs [34] stated that there were no records for in-referrals at any FRU and only 2 out of 12 FRU studied had some records for out-referrals. The in-referred cases did not carry referral notes, and there were no mechanisms for providing feedback to referring units.

A recent study in 2014 reported that 97% of referrals were before delivery, and 60% were admitted at the first institution before referral. Most of the first referrals were received at government tertiary care centers(73%), followed by private hospitals(15.3%) and CHCs(11.7%). The former two worked as CEmOCs, and the CHCs were mostly BEmOCs. Most of the first referrals at tertiary care centres were received from CHCs(65.4%) and PHCs(24.7%). Most of the first referrals at private care centres were from CHCs(70.6%) and remaining were from other private hospitals. None of the referrals from PHCs were received in private hospital. There were 13 second referrals, received at government tertiary care centres and private hospitals [36].

Table 4 summarises the problem issues in referral of obstetric cases.

Discussion

Level of obstetric care and proportion of referrals

This review suggests that about one-third to one-half of pregnancies in rural populations are assessed as high risk and are referred from a Subcentre to a PHC or CHC for further antenatal check-up and delivery care (Table 3). Almost half of these are anaemia or short stature cases which add large numbers to the high risk obstetric population in India. Simultaneously, low

Table 4. Problem issues identified in institution-referrals for obstetric high-risk or complications.

Obstetric care and the proportion of referrals
1. High proportion of referrals from the peripheral health institutions.
2. Low skills and confidence of peripheral staff in identifying high-risk and complications, and providing stabilising care.
Classification of high risk pregnancy or complications in pregnancy
3. Confusion in the clinical criteria for referral: Some high-risk cases can be managed at BEmOC and may not need referral. Only the complication cases need to be referred. Clear definitions can help decide for appropriate referrals and avoid unnecessary referrals.
4. No standard guidelines for the management of high-risk conditions and complications at BEmOC. This could avoid unnecessary referrals.
5. Low confidence of nursing staff at delivery centres and PHCs to manage high-risk pregnancies and to induce labour despite SBA trainings, established referral linkages and transportation services.
Reaching appropriate referral facility
6. Bypassing CHCs: PHCs prefer to refer straight to district level secondary and tertiary care centres. This may be due to lack of information at Subcentres and PHCs about services available at mid-level institutions (CHC).
7. Non- uniform standards and availability of care despite defining an institution as PHC or CHC or BEmOC or CEmOC.
8. No transport interventions specifically for referrals between institutions.
Quality of referral
9. No emphasis on the quality of referral advice, referral notes and keeping referral records.
10. No formal communication and transportation arrangements between the institutions.
11. No audit on quality of antenatal and delivery care including referral from the peripheral centres.
12. Poor compliance: Need for complications awareness and readiness in the community, and emphasis on referral counselling.

doi:10.1371/journal.pone.0159793.t004

risk pregnant women delivering at Nurse run PHCs or Urban centres, which are capable of providing BEmOC care (except induction of labour), refer up to one-fifth to one-third of cases to a higher level institution. These findings suggest that about one-half to two-thirds of all pregnant women attending lower level health institutions are likely to be referred during pregnancy or delivery (Table 3). Studies in Africa suggested similar proportions. If protocols for antenatal high-risk identification and referral, along with referral for complications, are followed then 35–50% of pregnant women in Africa will need to be referred from peripheral institutions to the next level of care [44].

Two studies also found that, ANMs, Nurses and even MOs were not confident and did not have skills to provide EmOC and referral care [31,45]. The under-confident and unskilled health staff are likely to refer higher proportions of pregnant women on the slightest of indication of high risk or complication. The selected intervention studies in this review did not have pre-intervention proportions and comparison groups to ascertain above hypothesis.

Referral for high risk in pregnancy or complication in pregnancy

A study conducted in Tanzania in 2009 reported that 28% of women registered for ANC at peripheral health centre were referred to higher level hospitals. Out of the referred patients, 70% were referred due to demographic risks, 12% due to obstetric historical risks, 12% with prenatal complications and 5.5% with delivery and immediate postnatal complications. Only half of these referred women complied, and these were mainly women with obstetric historical risks and any complications [46]. The proportion of referrals in this study are lower than nurse-run centres in our review, probably because the centre in the Tanzanian study was run by a clinical doctor. A clinical doctor or a MO is likely to be more capable of managing obstetric high risk and complications as compared to the nurses, thus reducing the number of referrals to next level. One study in our review [36] suggested that 14.3% women were referred from a PHC and about 7.5% from CHC for delivery complications alone compared to 5.5% in the Tanzanian study. The commonest causes for referral were prolonged labour and rupture of membranes which could have–in theory- been managed at the referring institutions [36]. This suggests that there is tendency for over and unnecessary referral from peripheral institutions in the government sector.

We also observed that definitions of high risk and complications and referral indications were not uniform in the studies. The studies prior to 2000 focused primarily on high risk screening during antenatal care by ANM, VHWs or TBAs while in the later studies the focus was also on delivery services, identification of historic obstetric high-risks and complications, and referral from primary care institutions. It appears that antenatal high-risk identification and referral still continues although the Safe Motherhood strategies now emphasize providing basic natal care to all with early identification of obstetric complications and providing referral to appropriate EmOC care [47]. Decisions about referrals are often very complicated and confusing in the absence of guidelines.

Studies show that high risk prediction may not necessarily mean that the woman will have complication and many women identified as being at risk go on to have normal deliveries [48,49]. Jahn and De Brouwere identified a core set of indications for referral which would produce referral rates of 6% to 10% and reduce a lot of un-necessary high-risk referrals. These include mainly previous caesarean section, breech presentation, transverse lie, multiple gestation, hypertension, and severe anaemia [7]. One of the community-based studies in the review found that only 14.4% of all deliveries had any complications [26], and another study by Bang et al found that only 17.7% had any complications [50]. This suggests that if all the deliveries were to be managed at a functional BEmOC (capable of managing high risk) then there may not be high proportion of referrals to CEmOC.

Reaching an appropriate referral institution for high risk, complication or emergency

Findings of qualitative studies in the review suggest that referrals are haphazard and a pregnant woman at high risk or with complications did not get the required EmOC and had to go through several referrals before reaching the appropriate institution. The high proportion of referrals and the experiences faced during referral are probably a reason why pregnant women in India choose to deliver at private institutions or go directly to higher level government institutions to avoid the transfers [31,45].

A study by Chaturvedi in 2014 suggests that referrals from PHC were justified, however 69% were directly to more trusted tertiary care bypassing the CHC. About half the referrals from CHCs could have been managed at the CHC. Bypassing CHCs by the PHC, and unjustified referrals from CHC, point towards distrust and lack of confidence in CHCs for the management of complications. Interestingly, none of the in-referrals in any of the institutions in this study required to be referred further. Only 7.2% referrals had either two or three referrals [36].

Although many interventions have been implemented in India in the last decade for the transportation of pregnant women there are no interventions specifically for referrals between institutions [42,43]. Most PHCs and CHCs do not have their own ambulances and rely on services like '108' ambulances or other public private transports for transfers [51].

Assessment of CEmOCs in various states of India have shown that the number of complicated deliveries handled at referral institutions is far below the estimated need of around 15% of all pregnancies and 100% of all complications [33,52,53]. Despite of high proportion of referrals from lower institutions the referrals received at higher institutions for complications is highly inadequate. This may be due to poor compliance to referral or referrals are mostly for non-complicated high risk pregnancies or normal deliveries. A study in Tanzania suggested that only 1.2% of referrals to a referral institution were for any complication or emergency. Amongst the rest, 18% were high risk cases referred during the antenatal care [54].

Quality of referral

Studies in our review also reported that there were no referral records maintained and no proper referral documents provided to the pregnant women at the time of referral. Only in one study 73% of referrals were provided referral slips but they did not provide any information about clinical manifestations or treatment [36]. Studies in the review found that the complication cases were not adequately stabilised nor were they given first-line treatment before referral, and a large proportion did not comply with the referral at all. A few chose to go to their preferred institution. This may be due to poor communication and counselling skills of the sender, high cost, non-availability of transport and distrust in the referral institution. Compliance was better in the presence of an accompanier from the referring institution or where the nurse arranged for the transport and communicated about the case to the higher level institution [5].

India has a 108 free ambulance service in most parts of the country which is the mainstay for transfer from home and between institutions for pregnant women [55]. However a study in Gujarat on referral systems and transportation revealed that the focus of the system was more on the number of ambulances and drivers, and less on the number of referrals transported [21]. In Madhya Pradesh 63% of the referred cases used a Janani Express vehicle and average travel time was 1.25 hours between institutions. The study identified that factors contributing to poor quality of referral and delay in getting care were less about the availability of transport, due to higher utilization of schemes like JSY and Janani Express vehicle, than inadequacies of the staff in identification of complications, referral and communication with the nearest

appropriate institution and provision of pre-transfer first-line treatment. The study also identified delays in receiving care at the referral institution [36].

There was overall lack of monitoring of the referral system and accountability to patients. Murray et.al [56] recommends supervision and increasing accountability of care providers. Strand et.al [57] and Konganyuy et.al [58] suggest audits of referrals for obstetric emergencies to improve referral systems for obstetric care and prevent delays.

Three phases of delay regarding access to appropriate emergency obstetric care have been identified: Phase 1 delay caused by time spent in decision making; phase 2 delay resulting from time spent reaching an appropriate institution for care; and phase 3 delay caused by waiting for appropriate care after reaching an appropriate centre [59]. Inefficient institution-referral systems contribute mostly to phase 2 delays but may also contribute to phase 3 delays due to non-readiness of the hospital because of poor communication about the arrival. Misdirected referral may also lead to phase 2 delays by sending the patient to an institution which is incapable of managing the referred condition. This may even increase the severity of complication in due course.[10] On the other hand unjustified referrals may lead to underutilization of some centres and overcrowding at others [54]. Fig 3 describes the components of inappropriate institution-referrals and contribution to delays in obstetric care as understood from the review. Further research is required to understand the determinants of each of these components in Indian context.

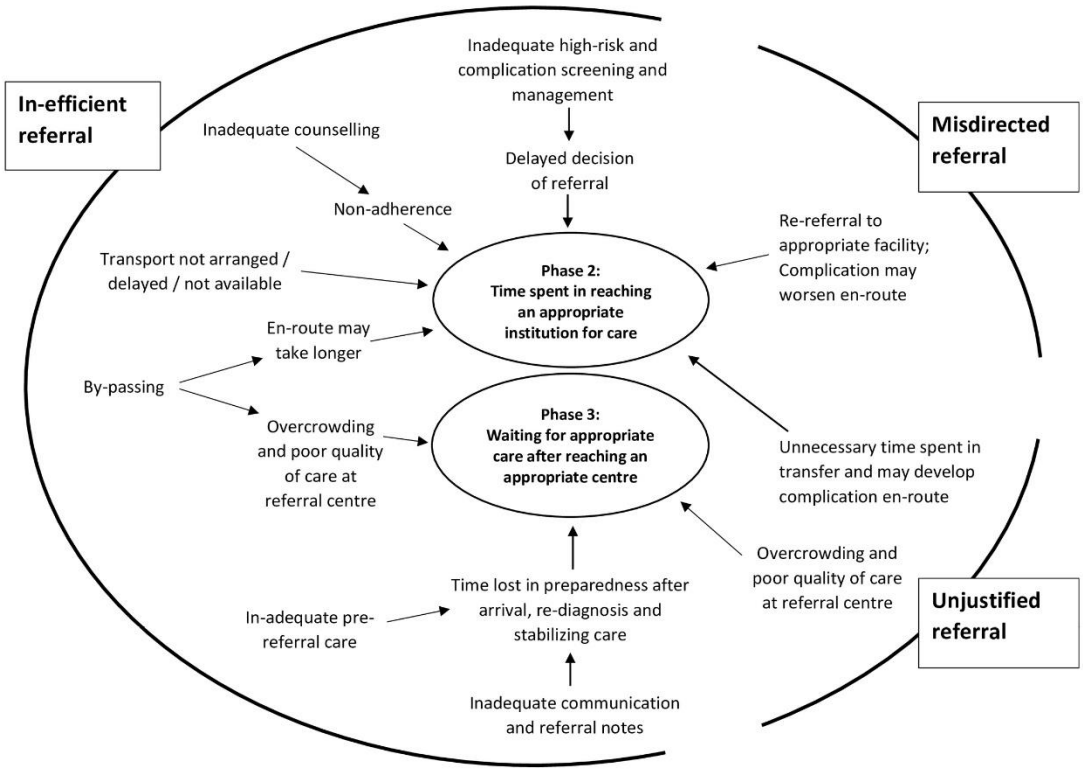


Fig 3. Inappropriate institution-referrals and contribution to delays in access to emergency obstetric care.

doi:10.1371/journal.pone.0159793.g003

A critical review on maternity referral systems, mainly institution-referrals, in developing countries found that there was considerable disparity between the hierarchical referral pyramid found in policy documents and the realities for women to access maternity care in many urban and rural settings [56]. Successful implementation of each referral system needs: a referral strategy informed by the assessment of population needs and health system capabilities, an adequately equipped referral institution, specific referral protocols, active collaboration between referral levels and other sectors, established communication and transport arrangements, affordable service costs, supervision and accountability for quality of care, the capacity to monitor effectiveness and policy support [56].

Strengths and Limitations

The systematic review is first of its kind to summarise evidence on referrals across different levels of care and for different indications in obstetric care in India. Restricting the review to India helped to understand referral criteria and pathways in the context of Indian health systems. The review emphasizes the need for development of clear referral protocols, and for the resources to implement them. The findings from the review will help the programmers to have an estimate of referrals and resources required, and also to identify future intervention research.

A few studies identified in this literature search were not included as they did not clearly mention if the participants were self-referrals or institution referrals. A few others did not mention results appropriately on proportions of referrals and causes of referrals. These studies, if reported well, could have added more evidence. Among the selected studies on out-referrals, the outcomes of pregnancy in terms of maternal and newborn morbidity and mortality and modes of transport and costs were not well reported. Thus we could not link the referrals with these variables. Most of the studies on out-referrals used interventions to improve referrals and did not report pre-intervention referral proportions, or have controls. It was thus difficult to combine results of the intervention and cross-sectional studies.

Conclusions

The proportion of institution-referrals was high. Referrals are a huge burden on the Indian health system, especially regarding transportation and management at higher institutions. Along with this, poor referrals may contribute to phase 2 and phase 3 delays. The high proportion of institution-referrals and pathways of referrals in India point towards a) the inability of primary health centres to provide basic delivery care and BEmOC services, b) inadequate pre-referral stabilizing care, c) a tendency for unjustified referrals to higher institutions, d) bypassing the CHCs as first referral choice, e) inadequate referral communication and record maintenance, and f) absence of standard guidelines for referral, facilities and monitoring of referrals for obstetric care.

Studies are required to assess the referral practices and problems faced by staff at lower level health institutions to decide when, where and how to refer the pregnant women. Strategies need to be developed a) to provide supervision and support to nurses for better BEmOC and referral, b) to standardize treatment and referral protocols and pathways, and c) monitor the quality of obstetric care and referrals from lower level health institutions and receiving these referrals at higher institution.

Supporting Information

S1 PRISMA Checklist. Prisma 2009 Checklist.
(DOC)

S1 Text. Search strategy for Referrals between public sector institutes for women with obstetric high risk, complications, or emergencies in India–A Systematic review.
(DOCX)

S2 Text.
(DOCX)

Author Contributions

Conceived and designed the experiments: SS PD OMC GVSM.

Performed the experiments: SS MM.

Analyzed the data: SS.

Wrote the paper: SS PD OMC GVSM.

References

1. WHO, UNFPA, UNICEF, World Bank. Trends in Maternal Mortality: 1990–2010. Geneva; 2012.
2. Khan KS, Wojdyla D, Say L, Gu Imezoglu AM, Van Look PF. WHO analysis of causes of maternal death: A systematic review. Lancet. 2006; 367:1066–1074. PMID: 16581405
3. AbouZahr C. Antepartum and postpartum hemorrhage. Chapter 4. In: Murray C, Lopez A, editors. Health dimensions of sex and reproduction. Boston: Harvard School of Public Health; 1998.
4. Campbell OM, Graham WJ. Strategies for reducing maternal mortality: getting on with what works. Lancet. 2006; 368(9543):1284–1299. PMID: 17027735
5. Gabrysch S, Civitelli G, Edmond KM, Mathai M, Ali M, Bhutta ZA, et al. New signal functions to measure the ability of health facilities to provide routine and emergency newborn care. PLoS Medicine. 2012; 9 (11):e1001340. doi: 10.1371/journal.pmed.1001340 PMID: 23152724
6. UNICEF, WHO, UNFPA. Guidelines for monitoring the availability and use of obstetric services. New York; 1997.
7. Jahn A, De Brouwere V. Referral in pregnancy and childbirth: Concepts and strategies. In: Press I, editor. De Brouwere V & Van Lerberghe W. Safe Motherhood Strategies: A review of the Evidence. Antwerp; 2001.
8. Nyamtema AS, Urassa DP, JV. R. Maternal health interventions in resource limited countries: a systematic review of packages, impacts and factors for change. BMC Pregnancy and Childbirth. 2011; 11:30. doi: 10.1186/1471-2393-11-30 PMID: 21496315
9. WHO. Mother-Baby-Package: Implementing safe motherhood in countries, Maternal Health and Safe Motherhood Programme. Geneva; 1994.
10. Hussein J, Kanguru L, Astin M, Munjanja S. The Effectiveness of Emergency Obstetric Referral Interventions in Developing Country Settings: A Systematic Review. PLoS medicine. 2012; 9(7):e1001264. doi: 10.1371/journal.pmed.1001264 PMID: 22807658
11. Registrar General of India. SRS: Maternal Mortality Ratio Bulletin 2011–2013. New Delhi: Registrar General of India; 2014. Available: http://www.censusindia.gov.in/vital_statistics/mmr_bulletin_2011-13.pdf. Acessed 20 April 2015.
12. MOHFW. Directory of Innovations Implemented in the health Sector. New Delhi: Government of India; 2008.
13. UNFPA. Concurrent assessment of Janani Suraksha Yojana (JSY) in selected states: Bihar, Madhya Pradesh,Orissa, Rajasthan, Uttar Pradesh. New Delhi: UNFPA- India; 2011.
14. NHSRC. Programme evaluation of the Janani Suraksha Yojana. New Delhi: MOHFW, Government of India; 2011.
15. Vora KS, Mavalankar D, Ramani KV, Upadhyaya M, Sharma B, Iyengar S, et al. Maternal health situation in India: A case study. Journal of Health Population and Nutrition. 2009; 27(2):184–201.
16. Lim SS, Dandona L, Hoisington JA, James SL, Hogan MC, et al. India's Janani Suraksha Yojana, conditional cash transfer programme to increase births in health facilities: an impact evaluation. Lancet. 2010; 375:2009–2023. doi: 10.1016/S0140-6736(10)60744-1 PMID: 20569841

17. Randive B, Diwan V, De Costa A. India's Conditional Cash Transfer Programme (the JSY) to Promote Institutional Birth: Is There an Association between Institutional Birth Proportion and Maternal Mortality? PLoS One. 2013; 8(6):e67452. doi: 10.1371/journal.pone.0067452 PMID: 23826302

18. Barnett S, Nair N, Tripathy P, Borghi J, Rath S, & Costello A. A prospective key informant surveillance system to measure maternal mortality—Findings from indigenous populations in Jharkhand and Orissa, India. BMC Pregnancy Childbirth, 2008; 8:6. doi: 10.1186/1471-2393-8-6 PMID: 18307796

19. UNICEF. Maternal and Perinatal Death Inquiry Response: Empowering communities to avert Maternal Deaths in India.2008. Available: www.unicef.org/india/MAPEDIR-Maternal_and_Perinatal Death_Inquiry_and_Response-India.pdf. Accessed 20 April 2013.

20. Singh S, Murthy GV, Thippaiah A, Upadhyaya S, Krishna M, Shukla R, et al. Community based maternal death review: lessons learned from ten districts in Andhra Pradesh, India. Matern Child Health J. 2015 Jul; 19(7):1447–54. doi: 10.1007/s10995-015-1678-1 PMID: 25636651

21. Gupta M, Mavalankar D, Trivedi P. A study of referral system for EmOC in Gujarat. PhD thesis, IIM Ahemedabad. 2009. Available: http://www.iimahd.ernet.in/publications/data/2009-06-02Gupta.pdf. Accessed 12 August 2015.

22. MOHFW. Rural Health Statistics in India 2013–14. New Delhi: Government of India; 2014. Available: https://nrhm-mis.nic.in/RURAL%20HEALTH%20STATISTICS/(A)%20RHS%20-%202014/Status%20of%20Facilities%20Available.pdf. Accessed 12 August 2015.

23. MOHFW. NUHM: Implementation framework. New Delhi: Government of India; 2013.

24. Maitra K, Singh KK, Sekhar CC, Saxena BN. A multicentre collaborative study of the care of mothers and infants with a comprehensive MCH care package utilizing high risk approach strategy at primary health centres: summary, conclusions and recommendations. Indian pediatrics. 1995; 32(1):67–72. PMID: 8617537

25. Hitesh J. Perceptions and constraints of pregnancy related referrals in rural Rajasthan. Journal of Family Welfare. 1996; 42(1):24–29.

26. McCord C, Premkumar R, Arole S, Arole R. Efficient and effective emergency obstetric care in a rural Indian community where most deliveries are at home. International Journal of Gynecology and Obstetrics. 2001; 75(3):297–307. PMID: 11728493

27. Barua A, Waghmare R, Venkiteswaran S. Implementing reproductive and child health services in rural Maharashtra, India: A pragmatic approach. Reproductive Health Matters. 2003; 11(21):140–149. PMID: 12800711

28. Iyengar K, Iyengar SD. Emergency obstetric care and referral: experience of two midwife-led health centres in rural Rajasthan, India. Reproductive Health Matters. 2009; 17(33):9–20. doi: 10.1016/S0968-8080(09)33459-X PMID: 19523578

29. More NS, Alcock G, Das S, Bapat U, Joshi W, Osrin D. Spoilt for choice? Cross-sectional study of care-seeking for health problems during pregnancy in Mumbai slums. Global Public Health. 2011; 6(7):746–759. doi: 10.1080/17441692.2010.520725 PMID: 20981600

30. David KV, Pricilla RA, Venkatesan S, Rahman SP GS, Vijayaselvi R. Outcomes of deliveries in a midwife-run labour room located at an urban health centre: results of a 5-year retrospective study. National Medical Journal of India. 2012; 25(6):323–326. PMID: 23998860

31. Alehagen SA, Finnstrom O, Hermansson GV, Somasundaram KV, Bangal VB, Patil A, et al. Nurse-based antenatal and child health care in rural India, implementation and effects—an Indian-Swedish collaboration. Rural and remote health. 2012; 12(3):2140. Epub 2012 Sep 6.

32. Pasha O, McClure EM, Wright LL, Saleem S, Goudar SS, Chomba E, et al. A combined community- and facility-based approach to improve pregnancy outcomes in low-resource settings: a Global Network cluster randomized trial. BMC Medicine 2013; 11:215. doi: 10.1186/1741-7015-11-215 PMID: 24090370

33. Biswas AB, Nandy S, Sinha RN, Das DK, Roy RN, Datta S. Status of maternal and new born care at first referral units in the state of West Bengal. Indian Journal of Public Health. 2004; 48(1):21–26. PMID: 15704722

34. Kaul V, Bagga R, Jain V, Gopalan S. The impact of primary postpartum hemorrhage in "near-miss" morbidity and mortality in a tertiary care hospital in North India. Indian Journal of Medical Sciences. 2006; 60(6):233–240. PMID: 16790949

35. Banerjee SK, Andersen KL, Warvadekar J. Pathways and consequences of unsafe abortion: A comparison among women with complications after induced and spontaneous abortions in Madhya Pradesh, India. International Journal of Gynecology and Obstetrics. 2012; 118(Suppl. 2):S113–S120. doi: 10.1016/S0020-7292(12)60009-5 PMID: 22920614

36. Chaturvedi S, Randive B, Diwan V, A. De Costa A. Quality of Obstetric Referral Services in India's JSY Cash Transfer Programme for Institutional Births: A Study from Madhya Pradesh Province. PLoS ONE. 2014; 9(5):e96773. doi: 10.1371/journal.pone.0096773 PMID: 24810416

37. Johnston HB VR, Lyall N, Agarwal K. Where do rural women obtain postabortion care? The case of Uttar Pradesh, India. International Family Planning Perspectives. 2003; 29(4):182–187. PMID: 14665427

38. George A. Persistence of High Maternal Mortality in Koppal District, Karnataka, India: Observed Service Delivery Constraints. Reproductive Health Matters. 2007; 15(30):91–102. PMID: 17938074

39. Vijayashree HY, Elias MA, Patil MR, Anil MH, Raveesha MR, Devadasan N, et al. 'She was referred from one hospital to another': evidence on emergency obstetric care in Karnataka, India. BMC Proceedings. 2012; 6(Suppl 5):15. doi: 10.1186/1753-6561-6-S5-P15

40. Pasha O, Goldenberg RL, McClure EM, Saleem S, Goudar SS, Althabe F, et al. Communities, birth attendants and health facilities: a continuum of emergency maternal and newborn care (the Global Network's EmONC trial). BMC Pregnancy and Childbirth. 2010; 10:82. doi: 10.1186/1471-2393-10-82 PMID: 21156060

41. Das V, Agrawal S, Agarwal A. Consequences of delay in obstetric care for maternal and perinatal outcomes. International Journal of Gynaecology and Obstetrics. 2010; 109(1):72–73. doi: 10.1016/j.ijgo.2009.11.003 PMID: 20022599

42. MOHFW. Janani Suraksha Yojana: Revised Guidelines for implementation. New Delhi: Government of India; 2006.

43. Department of Public Health & Family Welfare. Innovative Shemes and programme interventions under NRHM. Bhopal: Government of Madhya Pradesh; 2010.

44. Jahn A, Kowalewski M. The risk approach in antenatal care: Pitfalls of a global strategy. Curare. 1998; SB15:195–209.

45. Sodani PR, Sharma K. Training Needs Assessment of Public Health Professionals in Maternal and Neonatal Care. Indian Journal of Maternal and Child Health. 2011; 13(4):1–8.

46. Pembe AB, Carlstedt A, Urassa D, Lindmark G, Nyström L, Darj E. Effectiveness of maternal referral system in a rural setting: a case study from Rufiji district, Tanzania. BMC Health Services Research. 2010; 10:326. doi: 10.1186/1472-6963-10-326 PMID: 21129178

47. Inter-agency group for safe motherhood. The safe motherhood action agenda: Priorities for the next decade. Colombo, Srilanka; 1997.

48. Vanneste AM, Ronsmans C, Chakraborty J, De Francisco A. Prenatal screening in rural Bangladesh: from prediction to care. Health Policy Planning. 2000; 15:1–10. PMID: 10731229

49. McDonagh M. Is antenatal care effective in reducing maternal morbidity and mortality? Health Policy Planning. 1996; 11:1–15. PMID: 10155875

50. Bang RA, Bang AT, Reddy H, Deshmukh MD, Baitule SB, Filippi V. Maternal morbidity during labour and the puerperium in rural homes and the need for medical attention: A prospective observational study in Gadchiroli, India. BJOG: an International Journal of Obstetrics and Gynaecology. 2004; 111 (March):231–238.

51. Raj SS, Manthri S, Sahoo PK. Emergency referral transport for maternal complication: lessons from the community based maternal death audits in Unnao district, Uttar Pradesh, India. Int J Health Policy Manag 2015; 4:99–106. doi: 10.15171/ijhpm.2015.14 PMID: 25674573

52. Biswas AB, Das DK, Misra R, Roy RN, Ghosh D, Mitra K. Availability and Use of Emergency Obstetric Care Services in Four Districts of West Bengal, India. Journal of Health Population and Nutrition. 2005; 23(3):266–274.

53. Fauveau V, Donnay F. Can the process indicators for emergency obstetric care assess the progress of maternal mortality reduction programs? An examination of UNFPA Projects 2000–2004. International Journal of Gynecology and Obstetrics. 2006; 93:308–316. PMID: 16682038

54. Jahn A, Kowalewski M, Kimatta SS. Obstetric care in southern Tanzania: does it reach those in need? Tropical Medicine & International Health. 1998; 3(11):926–932.

55. Kumutha J, Rao GVR, Sridhar BN, Vidyasagar D. The GVK EMRI maternal and neonatal transport system in India: A mega plan for a mammoth problem. Seminars in Fetal & Neonatal Medicine. 2015; 20 (5).

56. Murraya SF, Pearson SC. Maternity referral systems in developing countries: Current knowledge and future research needs. Social Science & Medicine. 2006; 62:2205–2215.

57. Strand RT, de Campos PA, Paulsson G, de Oliveria J, Bergstorm S. Audit of referrals of obstetric emergencies in Angola: A tool for assessing quality of care. African Journal of Reproductive Health. 2009; 13(2):75–85. PMID: 20690251

58. Kongnyuy EJ, Mlava G, van den Broek N. Criteria-based audit to improve a district referral system in Malawi: a pilot study. BMC Health Services Research. 2008; 8:190. doi: 10.1186/1472-6963-8-190 PMID: 18808678

59. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. Social science & medicine. 1994; 38(8):1091–1110.

ANNEX III: SEARCH STRATEGY FOR SYSTEMATIC REVIEW- 'REFERRALS BETWEEN PUBLIC SECTOR HEALTH INSTITUTIONS FOR WOMEN WITH OBSTETRIC HIGH-RISK, COMPLICATIONS, OR EMERGENCIES IN INDIA'

1. "referral and consultation"/ or gatekeeping/ or physician self-referral/ or remote consultation/ or secondary care/ or tertiary healthcare/
2. (referral adj2 pathway*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
3. remote consultation/
4. telemedicine/
5. exp Transportation/
6. exp Transportation of Patients/
7. patient transfer/
8. exp transfer/
9. time factors/
10. communication/
11. telecommunications/
12. exp telephone/
13. (phone* or telephone* or cellphone* or mobile phone* or radio*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
14. interdisciplinary communication/
15. exp Emergency Medical Service Communication Systems/
16. emergency medical services/ or emergency service, hospital/
17. emergency treatment/
18. Emergencies/
19. triage/
20. First Aid/
21. exp hospitalization/

22. Maternal-Child Health Centres/

23. delivery of healthcare/

24. Health Services Accessibility/

25. health education/ or consumer health-information/

26. Ambulances/ or Air Ambulances/

27. (emergency adj1 (vehicle* or transport* or van* or car* or cycle* or bicycle* or ambulance*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

28. (emergenc* adj2 (respons* or referral*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

29. ((health or communit*) adj5 (work* or participant* or profession* or educat* or fund* or service*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

30. (refer or referral or transfer* or transport* or communication* or emergenc* or ambulance).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

31. ((train* or educat*) adj5 (matern* or health* or professional or doctor* or midwive* or midwife* or nurs*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

32. (ANM* or Midwife* or Nurse* or Skilled birth attendant* or Doctor* or Obstetr* or TBA*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

33. (Hospital or health centre).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

34. emergency service, hospital/ or trauma centres/

35. or/1-34

36. pregnancy/ or labo?r, obstetric/ or exp pregnancy outcome/

37. exp Pregnancy Complications/

38. delivery, obstetric/ or extraction, obstetrical/ or labor, induced/

39. Obstetrics/

40. exp Obstetric Labor Complications/

41. maternal health services/ or perinatal care/ or postnatal care/ or prenatal care/

42. obstetric care/

43. Maternal Mortality/

44. (ante-natal or antenatal or pre-natal or prenatal or natal or ante-partum or antepartum or post-natal or postnatal or post-partum or postpartum).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

45. (peri-natal or perinatal).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

46. (labo?r or delivery or birth or childbirth).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

47. pregnan*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

48. matern*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

49. (maternal adj3 (morbidity or mortality or outcome*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

50. infant/ or infant, newborn/

51. neonat*.mp.

52. (neonat* adj3 (morbidity or mortality or outcome or infections or illness)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

53. obstructed labo?r.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

54. (eclampsia or pre-eclampsia).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

55. ((obstetric or postpartum or post-partum) adj3 h?emorrhage).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

56. ((genital or urin*) adj3 infect*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

57. (ruptur* adj4 (uterus or uterine)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

58. ((prolonged or obstructed) adj2 (labo?r or birth or delivery)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

59. ((postpartum or post-partum) adj1 (sepsis or septicemia or fever)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

60. ((thirdstage or third-stage) adj1 labo?r).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
61. (BEmOC or EmOC or CEmOC).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
62. ((highrisk* or high-risk*) adj2 (pregnan* or obstetric* or gestation* or delivery or labo?r or birth or antenatal or ante-natal or prenatal or peri-natal or postnatal or post-natal)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
63. (matern* adj2 (hospital or centre or health centre)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
64. (emergenc* adj2 obstetric*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
65. (obstetric adj3 care*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
66. or/36-65
67. India.mp. or India/
68. 35 and 66 and 67
69. limit 68 to (human and english language and yr="1991 -Current")

ANNEX IV: QUESTIONNAIRE FOR KAP SURVEY

Interview of ANM, Staff nurse, and Doctor at PHC/ CHC/ AH

Si. No : _____ District : _____ Date : _____

Name of the institution : _____ Type - PHC / CHC / AH:_____

Designation: Obstetrician/ Medical officer/ Staff nurse/ ANM: _____

Years of working in current position: _____ Total years of service: _____

SiNo.	Question	Options	Response
1.	What is the highest degree you have studied?	1. Post graduate and above 2. Graduate 3. Diploma 4. 12th	
2.	Have you received training for skilled birth attendance?	1. Yes 2. No 3. Don't know	
2a.	If yes, how many years back did you receive Skilled Birth Attendance (SBA) training?	Years	
2b.	If yes, did you receive any refresher training regarding SBA?	1. Yes 2. No 3. Don't know	
3.	Have you received any training for care in pregnancy and child birth?	1. Yes 2. No 3. Don't know	
3a.	If yes, how many years back did you receive this training?	Years	
	ANTENATAL CARE		
4.	What are the indications of referral for antenatal woman from your centre? *(Ask her/him to enumerate. Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Moderate to severe anaemia	
		2. Swelling in feet	
		3. High blood pressure	
		4. PIH / Pre-eclampsia	
		5. Eclampsia	
		6. Bleeding in pregnancy / APH	
		7. High fever	
		8. Diabetes / Thyroid disease	
		9. Multiple foetus	
		10. Breech in 8-9 month	
		11. Transverse lie in 8-9 month	
		12. Decreased foetal heart sound/ movements	
		13. Previous caesarean section	
		14. Previous abortions / preterm birth / stillbirth	
		15. Elderly primigravida	
		16. Gravida $\geq$ 4	
		17. HIV positive mother	
		18. Others, specify	
5.	What high-risk or complications do you screen in antenatal checkup in your centre? *(Ask her/him to enumerate. Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Moderate to severe anaemia	
		2. Swelling in feet	
		3. High blood pressure	
		4. PIH / Pre-eclampsia	
		5. Eclampsia	
		6. Bleeding in pregnancy / APH	

		7. High fever	
		8. Diabetes / Thyroid disease	
		9. Multiple foetus	
		10. Breech in 8-9 month	
		11. Transverse lie in 8-9 month	
		12. Decreased foetal heart sound/ movements	
		13. Previous caesarean section	
		14. Previous abortions / preterm birth / stillbirth	
		15. Elderly primigravida	
		16. Gravida $\geq$ 4	
		17. HIV positive mother	
		18. Others, specify	
6.	What lab investigations do you do / suggest to be done for antenatal woman? *(Ask her/him to enumerate. Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Haemoglobin	
		2. Blood group	
		3. Urine albumin	
		4. Random blood sugar	
		5. HIV testing	
		6. HBs Ag testing	
		7. VDRL	
		8. Ultrasonography	
		9. Others, specify	
7.	What do you do if you find any of these high-risk / complication during antenatal checkup? *(Ask her/him for each of the options enumerated below)* ↓ *Read the responses and help her/him understand these* →	1. Refer for further ANC 2. Advise to continue ANC at your institution and deliver at the referral institution 3. Manage ANC and delivery at your institution	
	1. Severe anaemia		
	2. Swelling in feet		
	3. High blood pressure		
	4. Pre-eclampsia		
	5. Eclampsia		
	6. Bleeding in pregnancy / APH		
	7. High fever		
	8. Heart disease / Diabetes / Thyroid disease		
	9. Multiple foetus		
	10. Breech in 8-9 month		
	11. Transverse lie in 8-9 month		
	12. Decreased foetal heart sound/ movements		
	13. Previous caesarean section		
	14. Previous abortions / preterm birth / stillbirth		
	15. Primigravida >35 years		
	16. Gravida $\geq$ 4		
	17. HIV positive mother		
8.	Where do you refer the antenatal woman, if required? *(Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. PHC	
		2. CHC	
		3. Area / Sub-block hospital	
		4. District hospital	
		5. Medical college	

		6. Private doctor	
		7. Private hospital	
9.	How do you organise referral? *(Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Write a referral note	
		2. Counsel the care takers regarding referral	
		3. Advise to call 108	
		4. Arrange transport for referral	
		5. Communicate via phone to referral institution	
		6. Provide stabilising care before referral	
10.	What do you do in the following scenario? *(Ask her/him for each of the options enumerated below. Don't give response options)*		
10a.	Primigravida in 2nd trimester is found to have haemoglobin of 7gm% and no other high-risk or complication. On per abdomen examination foetal movements are palpable. *(Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Diagnosis	
		2. Start oral iron supplements twice in a day.	
		3. Give injectable iron	
		4. Give blood transfusion	
		5. Give tablet mebendazole	
		6. Refer to higher level	
		7. Others, specify	
10b.	In third trimester pregnant woman on her 4th routine antenatal check-up has blood pressure 160 mm Hg systolic and pulse rate 80/minute. No previous history of high blood pressure. Per abdomen examination finds that foetus has cephalic lie and heart sounds are normal. Biochemical tests show she has haemoglobin 10.5gm%, random blood sugar 80gm% and 3+ protein in urine. *(Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Diagnosis	
		2. Give tablet methyldopa / labetalol one daily	
		3. Blood pressure monitoring	
		4. Give $MgSo_4$ injection	
		5. Refer to higher level for treatment	
		6. Advise rest	
		7. Advice low salt diet	
10c.	Second gravida women comes to centre in 30wks of gestation with labour pains. On examinations pulse rate and blood pressure are normal. On per abdomen examination strong uterine contractions observed. Foetal movements and heart sound are normal. She has haemoglobin 11gm%, Random Blood sugar 100gm% and urine albumin and sugar are negative. *(Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Give tocolytics to delay labour	
		2. Give Inj. Dexamethasone	
		3. Advise bed rest	
		4. Assist delivery	
		5. Refer to higher level	
		6. Refer the newborn after child birth	
11.	Do you give referral slip before referral?	1. Yes 2. No 3. Don't know	
12.	Do you arrange for transport in case of emergency referral?	1. Yes 2. No 3. Don't know	
12a.	If yes, then what vehicle? *(Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. 108	
		2. Ambulance from the centre	
		3. Other subsidised vehicle	
13.	Do you inform the referring facility by phone?	1. Yes 2. No 3. Don't know	

14. Do you feel confident to manage ANC and delivery or require some support for the following maternal conditions at your centre?
(Read the column heads clearly and make her/him understand. Ask for each of the row items. Put 'X' in the appropriate boxes) (Multiple answers possible)

SiNo.	Condition of pregnant women	Confident to manage ANC and delivery	Confident to manage ANC BUT will refer for delivery	Confident to manage ANC and deliver BUT require equipment	Need training and supervision for ANC and / or delivery	Need training and supervision and, equipment for ANC and / or delivery	ANC and delivery Should not be managed at this centre
1.	Moderate to severe anaemia						
2.	Swelling in feet						
3.	Previous caesarean section						
4.	Previous abortions / preterm birth / stillbirth						
5.	High blood pressure						
6.	PIH / Pre-eclampsia						
7.	Eclampsia						
8.	Bleeding in pregnancy / APH						
9.	High fever						
10.	Diabetes / Thyroid disease						
11.	Multiple foetus						
12.	Breech in 8-9 month						
13.	Transverse lie in 8-9 month						
14.	Decreased foetal heart sound/ movements						
15.	Elderly primigravida						
16.	Gravida $\geq$ 4						
17.	HIV positive						

15. What problems do you face in referring antenatal women?
    1. _____ 3. _____
    2. _____ 4. _____
16. What support do you require to be able to efficiently diagnose and refer antenatal women in need?
    1. _____ 3._____
    2. _____ 4. _____

LABOUR AND CHILD BIRTH			
SiNo.	Question	Options	Response
17.	How many deliveries (approximately) have you assisted between April and September 2015?	Number	
18.	Have you been trained for use of Partograph? *(Skip to 22 if don't know about partograph)*	1. Yes 2. No 3. DK partograph	
19.	How often do you use partograph for monitoring labour?	1. Always 2. Most of the time 3. Sometimes 4. Never	
20.	In your opinion does partograph help you monitor labour better?	1. Yes 2. No 3. Can't say	
21.	What all is recorded in partograph? *(Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Maternal heart rate	
		2. Maternal blood pressure	
		3. Maternal temperature	
		4. Maternal contractions	
		5. Cervix dilatation	
		6. Foetal heart sound	
		7. Colour of amniotic fluid	
		8. Others	
		9. Don't know	
22.	Have you been trained for use of safe birth checklist?	1. Yes 2. No 3. Don't know about SBC	
23.	What are the indications of referral during labour or child birth? *(Ask her/him to enumerate. Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Preterm labour <32 weeks	
		2. Pre-mature rupture of membranes <37 weeks	
		3. Rupture of membranes >12 hrs without labour or > 18 hours with labour	
		4. Obstructed labour	
		5. High blood pressure	
		6. PIH / Pre-eclampsia	
		7. Eclampsia / convulsions	
		8. High fever	
		9. Meconium stained liquor	
		10. Moderate to severe anaemia	
		11. Diabetes / Thyroid disease	
		12. Multiple foetus	
		13. Breech presentation	
		14. Transverse lie	
		15. Foetal distress	
		16. Retained placenta / products	
		17. Excessive bleeding	
		18. Previous caesarean section	
		19. Previous abortions / preterm birth / stillbirth	
		20. Elderly primigravida	
		21. Gravida $\geq$ 4	
		22. Others, specify	
24.	What high-risk or complications do you screen for, during labour and child birth?	1. Preterm labour <32 weeks	
		2. Pre-mature rupture of membranes <37 weeks	

	(Ask her/him to enumerate. Don't give response options) *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	3. Rupture of membranes >12 hrs without labour or > 18 hours with labour	
		4. Obstructed labour	
		5. High blood pressure	
		6. PIH / Pre-eclampsia	
		7. Eclampsia / convulsions	
		8. High fever	
		9. Meconium stained liquor	
		10. Moderate to severe anaemia	
		11. Diabetes / Thyroid disease	
		12. Multiple foetus	
		13. Breech presentation	
		14. Transverse lie	
		15. Foetal distress	
		16. Retained placenta / products	
		17. Excessive bleeding	
		18. Previous caesarean section	
		19. Previous abortions / preterm birth / stillbirth	
		20. Elderly primigravida	
		21. Gravida $\geq$ 4	
		22. Others, specify	
25.	What lab investigations do you review from past tests / suggest to be done during labour and child birth? *(Ask her/him to enumerate. Don't give response options)* *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Haemoglobin	
		2. Blood group	
		3. Urine albumin	
		4. Random Blood sugar	
		5. HIV testing	
		6. HBs Ag testing	
		7. VDRL	
		8. Ultra-sonography	
		9. Others, specify	
26.	What do you do if you find any of these high-risk / complication during early labour and child birth? *(Ask her/him for each of the options enumerated below)* ↓ *Read the responses and help her/him understand these* →	1. Assist child birth 2. Assist child birth only if cervix dilated >6cms 3. Don't attempt assisting and refer after stabilising 4. Don't attempt assisting and refer without stabilising 5. Call for help 6. Do not do anything	
	1. Preterm labour <32 weeks		
	2. Pre-mature rupture of membranes <37 weeks		
	3. Rupture of membranes >12 hrs without labour or > 18 hours with labour		
	4. Obstructed labour		
	5. High blood pressure		
	6. PIH / Pre-eclampsia		
	7. Eclampsia / convulsions		
	8. High fever		
	9. Meconium stained liquor		
	10. Moderate to severe anaemia		
	11. Diabetes / Thyroid disease		
	12. Multiple foetus		

	13. Breech presentation		
	14. Transverse lie		
	15. Foetal distress		
	16. Retained placenta / products		
	17. Excessive bleeding		
	18. Previous caesarean section		
	19. Previous abortions / preterm birth / stillbirth		
	20. Elderly primigravida		
	21. Gravida $\geq$ 4		
27.	Do you ever induce or augment labour?	1. Yes 2. Only under supervision 3. Never of MO / Obstetrician	
28.	Do you give Inj Oxytocin 10 IU to mother within one minute of child birth?	1. Yes 2. No 3.Don't have it 4. Don't know about it	
29.	How do you assist in delivering placenta? *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Give controlled cord traction	
		2. Give uterine massage	
		3. Wait for 30 min	
30.	If placenta is not delivered in 30 minutes, what do you do? *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Manually remove placenta	
		2. Give oxytocin in i/v fluids	
		3. Give Inj antibiotics	
		4. Refer to higher facility	
31.	What do you do in the following scenario? *(Don't give response options)*		
31a.	Pregnant woman is a diagnosed case of pregnancy induced hypertension and she is on treatment. She visits the centre in active labour stage 2. At the time of the visit her pulse rate was 84/min and BP is 122mmHg/84mmHg. Per abdomen foetal heart sound is 140/min. *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Continue anti-hypertensive treatment	
		2. Give injectable $MgSo_4$ injection	
		3. Assist delivery	
		4. Refer to higher level	
		5. Others, specify	
31b.	A primigravida women is delivering at the centre. The baby has vertex presentation but during child birth, the head is obstructed. Women is exhausted and can't bear pains. How would you manage this case? *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Caesarean section	
		2. Use vacuum or forceps	
		3. Give oxytocin in I/V drip	
		4. Refer to higher level for treatment	
31c.	During stage 2 of labour you notice the liquor is meconium stained. Mother is bearing normal labour pains. Foetal heart sounds are 150/min. Vaginal examination finds vertex presentation and cervix 4cm dilated. How would you manage this case? *(Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. Assist delivery	
		2. Mucus suction from baby	
		3. Bag and mask resuscitation	
		4. Refer before child birth	
		5. Refer after child birth	
32.	Do you give referral slip before referral?	1. Yes 2. No 3. Don't know	
33.	Do you arrange for transport?	1. Yes 2. No 3. Don't know	
33a.	If yes, then what vehicle? *(Don't give response options) (Multiple choices possible. If s/he mentions any of these then write 1, else write 0)*	1. 108	
		2. Ambulance from the centre	
		3. Other subsidised vehicle	
34.	Do you inform the referring facility by phone?	1. Yes 2. No 3. Don't know	
35.	Does JSSK help you provide better services for care in child birth?	1. Yes 2. No 3. Face problems availing JSK fund	

36. Do you feel confident to manage delivery or require some support for the following maternal conditions at your centre? *(Read the column heads clearly and make her/him understand. Ask for each of the row items. Put 'X' in the appropriate boxes) (Multiple answers possible)*

SiNo.	Condition of pregnant woman	Confident to manage delivery	Confident to manage delivery BUT need equipment and assistance	Need training and supervision for managing delivery	Need training and supervision and, equipment and assistance for managing delivery	Should not be managed at this centre
1.	Preterm labour <32 wks					
2.	Pre-mature rupture of membranes <37 weeks					
3.	Rupture of membranes >12 hrs without labour or > 18 hours with labour					
4.	Obstructed labour					
5.	High blood pressure during child birth					
6.	High fever					
7.	Meconium stained liquor					
8.	Multiple foetus					
9.	Breech presentation					
10.	Transverse lie					
11.	Foetal distress					
12.	Retained placenta / products					
13.	Excessive bleeding					

37. What problems do you face in referring women in labour?

1. _____ 3. _____
2. _____ 4. _____

38. What support do you require to be able to efficiently diagnose and refer women in labour?

1. _____ 3. _____
2. _____ 4. _____

Remarks:

_____

_____

ANNEX VA: CASE STUDIES OF PROVIDERS

5.1 Motivation of health staff and (no) support from health system

5.1.1 Doctor, PHC Patta Mehlog, Himachal Pradesh

The doctor showed us the letter of appreciation he received from one of the most premier research institutions in the country, PGI Chandigarh, for saving life of a newborn who had aspirated meconium during birth. He describes,

'*The women arrived very late in labour and had thick meconium stained liquor. The baby did not cry after birth and was asphyxiated*. *I put in the Ryle's tube and using 10ml syringe aspirated about 25ml of meconium and resuscitated the baby. Once the baby revived I referred him to PGI Chandigarh along with the aspirated meconium in the bottle. I am happy they acknowledged my efforts.*'

The doctor had never received any appreciation from his seniors in the system. He is in-charge of a PHC at Patta Mehlog, Solan district. He managed his PHC with support from only one young staff nurse and a TBA. The PHC was located beside a busy state highway and received high load of patients including a few accident cases every day. Earlier there were three doctors and two staff nurses in this PHC and the team managed the patient load efficiently. One of the doctors left on sabbatical for higher studies. Another one requested for transfer due to the events that arose after a conflict between the doctor and a drunken case of accident. Despite of complaints of harassment neither the health system nor the community provided any support to the doctor. Embarrassed and hurt by the community's reaction, the doctor herself requested health minister for transfer.

'Whom do we work for, the community who no more respects us or the system that refuses to own us and provide protection.'

There are a very few PHCs in Himachal Pradesh that provide obstetric delivery care and Patta Mehlog is one of them. But the number of deliveries managed has come down in number since the time there were three Doctors here. The PHC building was newly built and had a very well maintained labour room with all basic equipment, lab and other facilities. But there were no apartments for living for the staff. The old PHC building still

persisted and the doctor had acquired the old doctor's room, the staff nurse had accommodated in one of the wards and the lab technician in another ward. The same room served as living room, bed room and the kitchen. There was no security, neither for the new hospital nor the residence. The PHC was situated little outside of the local village on the highway and in case of any trouble, the staff would not be able to call out for immediate help.

'We work in such conditions and do our best to sustain. There is no replacement doctor and my senior often refuses me leaves. I hear complaints from the community. Am I not entitled for a respectful, much earned leave once in a while? Is this what a doctor live and aspire for and that too for a salary of about INR 30,000 (£350) a month?

All three, the doctor, staff nurse and TBA have received the SBA training. However, the doctor admitted that he had learned most of his obstetric skills from the staff nurse and the TBA he worked with. The TBA did not want to unduly medicalise delivery process. At the same time, he also had to limit some of her harmful practices such as pushing on the abdomen during labour. Whether to attend a delivery case or to refer was mostly a joint decision. He was glad that he had a wonderful team. They managed most of the deliveries and referred only when absolutely necessary.

'*My contemporaries in nearby PHCs do not conduct any deliveries. They say it is not possible to run a PHC 24X7 with one doctor and one nurse in place. We, however, try and manage low-risk and some complicated deliveries at this centre. We refer the low-risk (obstetric) cases only when we don't have a choice. Although the staff nurse and Dai (TBA) can handle low-risk cases they find it more secure if I am around. Even on leave, I stay available over the phone.'*

'We often do not have a cleaner. You will be surprised if I tell you that we clean the labour room ourselves. I and my team are committed to provide delivery care.

On further enquiry about support from contemporaries and superintendents he retorted,

'My block superintendent does not appreciate or support me. I have often requested for a second doctor or a staff nurse and some more equipment for managing mild complications. He (block superintendent) says you are not an Obstetrician thus don't

bother for high-risk and complicated cases, just refer them using '108'. What shall I do if my patient refuses to go? What if a low-risk mother develops a complication during delivery? In such cases, you receive complaints from the patient's family and letters from district headquarters demanding for explanations.'

'My contemporaries have already given up and often ask me why I need to do that extra. I try to do the best I can do for the patient in this centre or refer the case after stabilising. Sometimes we go without sleep for 2 straight nights.'

Doctor summed up the interview with sad words.

'*It has been 5 years and I am done here. I have passed my post-graduate entrance examination. I look forward to joining a medical college and live closer to the city of Shimla and take care of my mother and sister.'*

The staff nurse also told that she shall ask for transfer soon. We wonder, will the PHC Pata Mehlog continue to be a much appreciated delivery point or the next doctor would just surrender to the system as many do.

5.1.2 Doctor, PHC Ramsehar, Himachal Pradesh

The doctor had experience of over 30 years. His previous posting was in a CHC where he had a good team that provided obstetric care. He took charge of PHC Ramsehar four years back and that time the PHC had one ANM and one lab technician to support the doctor and they did not assist any deliveries at the centre.

The ANM in PHC told that the doctor had very good rapport in the community and, even the very sick patients came to him for his opinion. When we arrived, the doctor was training the ANMs, ASHAs and male-MPHWs regarding the Rota-virus vaccine for the infants—newly introduced by the system. He mentioned that he was not trained about this vaccine but he was sent training material to train his staff.

'*These days PHCs and staff here don't get much importance and respect. Earlier we could do minor surgeries and most deliveries at our centres with the support of the staff and community. But now we are told not to take a risk, and refer all delivery cases. Over a period of time, I have seen the degradation in the status of PHCs by the system. These are*

times of specialists and no one wants to take accountability of the basic health care to be provided to the patient.'

The doctor initiated the provision of antenatal care and delivery care at this health centre but that did not go well. He stated that a normal labour can lead to complication anytime and would require referral. But due to lack of proper linkages and support the patients suffered.

'When I referred some complication cases to Civil hospital Nalagarh, the block officer and Superintendent told me not to deliver women at our PHC. The system doesn't want to take responsibility of any mishap.'

'My patients report that they were not attended well in (Civil hospital) Nalagarh. I accompanied a few serious cases. It would take about 45 minutes to an hour to reach there. One of the patients I accompanied was admitted upon my insistence. As soon as I left, the patient was referred to Chandigarh, another hour and a half away. I am confident that the patient did not need a further referral but as the obstetrician had somewhere else to go and he could not entrust the responsibility of a sick case on anyone, he referred the case. This has happened a few times and then I stopped conducting deliveries at my PHC. I realised my patients suffer more due to these non-compatibility issues.'

Even the antenatal women referred for investigations had to wait in long lines. *'It is faster if you register as a new patient at the Civil hospital and then go through all investigations. I tell my patients not to mention that they have been referred.'*

The doctor has on several occasions complained about the working of referral centre. But the region has only one obstetrician thus Government has no choice but to keep up with him. *'Nalagarh is conducting many deliveries but the way things are done there is not helping the sick mothers. The deliveries are conducted by the Dais (TBAs) in the hospital, often unsupervised. There are several cases of pre-mature episiotomy, tears and extensive blood loss among my patients who delivered there. Is delivering by trained Dai (TBA) there better than delivering at PHC by a trained doctor or a nurse? They say strengthen the primary health care system but they promote specialist care at the secondary level.'*

He clearly stated that '*the problem faced in referral is that there is no referral system*.'

5.1.3 Doctor, PHC Samot Himachal Pradesh

'*We are isolated here and there is no one of similar interests to talk. No social life whatsoever and not much interaction even with the villagers… no regular television or the internet. I sometimes visit the doctors in neighbouring PHCs. If you ask me to live here for long, I don't think that is humanly possible-not with a contractual position and a salary of INR 25,000 (£300) per month.'*

He is a young doctor who took charge of this PHC a few months back and feels desolate. He expressed that it is unfair on part of the system to expect young doctors to become in-charge of a centre with minimal supervisory support. The three nurses posted there are also new and with the support of each other, they just about manage. Deliveries are mostly conducted by the staff nurses and only in case of any high-risk or complication the doctor is called. The centre assisted average 20-30 deliveries. The two referral centres were about 50-60 kilometres i.e. one and a half to two hours journey. The doctor had some complains about '108'.

'We don't have an ambulance and '108' takes longer to reach here. It is frustrating when the doctor at '108' call centre argues about my decision of referral. On an average, it takes 5-10 minutes of repeated calling and discussions to convince him to send an ambulance.'

The doctor explained to us that the decision to refer is not just about the availability of drugs and equipment and doctor at PHC. It is also to do with the skills of the doctor, support and confidence of the staff, and acceptance of the community.

'*My team here is young and we don't experiment too much. With the slightest risk and indication of complication, we refer because we know if things worsen then it would take at least two and half hours from arranging a vehicle to reaching the referral centre. And in the meanwhile, we will have to bear the brunt from the community as well. We are motivated to serve but not at the risk of the patients' life. It would be beneficial if we could talk to an obstetrician over phone and seek advice.'* The doctor stated that the PHCs in Himachal Pradesh run on an adhoc basis and system doesn't do enough to help doctors sustain in these difficult areas.

'*I know I would not stay here for long, so I want to make best of it for myself and the local community. I am glad to have a senior at block office who helps me through in difficult situations.'*

5.1.4 Staff nurses at various hospitals

All the staff nurses stated a common fact in their interviews that the decision to refer a pregnant women was made by the doctor.

'*We know the treatment protocols, still, we first call the doctor in-charge and do as per his instructions. Even if we have to give any medicine for high blood pressure or magnesium sulphate, anything, we ask the doctor.'-Nurse at a CHC*

'It is the doctor's responsibility to manage any complication. If the doctor is not in the centre, I prefer to refer the high-risk or complication cases, but of course after informing the doctor.' –Nurse at a PHC

In Andhra Pradesh, we observed that the young nurses were enthusiastic but reluctant in taking decisions for pregnant women with high-risk condition or complication. A telephonic assurance or decision from the doctor helped them to decide management of a case. On the other hand, experienced nurses could provide confidence to a young doctor and help him keep calm while managing a difficult case.

Himachal Pradesh government rotated staff nurses between different levels of care. We met two staff nurses who had worked in a District hospital labour room and were now posted in the CHCs or PHCs. They were more confident in managing a delivery case by themselves. They had direct telephonic access to the senior nurses and obstetricians in the District hospitals, whom they could call in case of any emergency for discussing the management. However, where the staff nurse was not supported by a skilled doctor, she did not want to own the responsibility of managing a women in labour.

'*There is hardly any work in this PHC. I have worked in big hospitals and I want to provide similar care here. But even if I am interested to start labour room service, I wouldn't do it without the support of the doctor. At the end of the day if there is any complication, then it is the doctor's responsibility for managing the case. Our doctor is not trained for this so I do not insist.'* –Staff nurse, PHC (not a delivery point)

One of the head nurses at a Sub-district hospital in Himachal Pradesh mentioned that the deliveries were assisted by the TBAs and the nurses on duty rarely supervised the TBA*s* despite repeated instructions.

'The young nurses do not own their responsibilities in the labour room. The nurses don't assist deliveries neither do they directly supervise the Dais (TBAs), unless Dai (TBA) said it is a complication and they need help.' –Head staff nurse, Sub-district Hospital, Himachal Pradesh.

5.2 Overreliance on a single obstetrician at a CHC or a Sub-district hospital

5.2.1 Obstetrician at Civil hospital Nalagarh, Solan, Himachal Pradesh

'Everything is fine here. We do proper screening and management for high-risk and complications and referral. We get referrals from a vast area and we conduct upto 50-60 deliveries a month. We have no problem with referrals.'

At first, the obstetrician at the hospital was not willing to talk much but he had more to say.

'Our system assumes that I have a magic wand in hand. We are a referral centre and I am the sole person responsible for the pregnant women delivering here, who are mostly with complications. I have OPD to attend, and untimely call for serious delivery cases and caesareans. When I am not on duty, the other doctors on duty are usually specialists like paediatrician and dentists etc. Do you think they (other experts) have expertise to manage obstetric cases? They do as much as they can. They call me or refer cases. We may thus have variable referral out rates. Do you realise I am at job 24X7X365 and we are doing our best?'

In his opinion, general doctors at PHCs and CHCs neither had motivation nor ability to manage obstetric cases. '*No one except a few PHCs and CHCs are conducting any deliveries. We are overcrowded and have a high in-referral load.'*

About the role of support from nursing staff he mentioned that the hospital had staff nurses exclusively posted in labour room and they were supported by 3 TBAs. The low-

risk deliveries were mostly conducted by the TBA*s* and staff nurses supervised them. In his absence, staff nurses managed complications themselves or referred.

The hospital did not have a blood bank facility. For some patients, they arranged blood from private blood banks but referred others. It appeared to us that there might be a higher proportion of out-referrals than expected from a hospital with an obstetrician such as this.

5.2.2 Obstetrician at CHC Gurazala, Guntur, Andhra Pradesh

The obstetrician is highly motivated and confident to manage obstetric emergencies. The CHC has blood storage facility and busy caesarean operation theatre. He mentioned that the CHC had good linkages with the lower facilities and the Senior Public Health Specialist (SPHO) helped in linking PHC doctor with the CHC obstetrician. The CHC obstetrician, however, stated that the linkages with higher centres and support from the district officials were non-existent. Earlier he managed most of the obstetric emergencies at his centre with support from physician, paediatrician and staff nurses. But now he do not manage severe cases.

'They (District officials) asked me not to deliver cases with Eclampsia. I no longer manage serious complications, except when my patient refuses to accept the referral.'

'I have been managing haemorrhage, PIH, and eclampsia cases efficiently since over a decade. Once one of my eclampsia cases worsened. I referred her but she succumbed to death in the referral centre. During maternal death review, they asked me why I managed complications at CHC. What is the purpose of us being a first referral centre when we are not entrusted to manage complications?'

He stated that since the introduction of maternal death reviews, doctors in lower facilities were unnecessarily blamed. The doctors who actually provide patient care faced the consequences, while those who did not provide delivery care were spared.

'The district administration does not trust us and support our decision. The administration does not want to own any responsibility for complication cases or any maternal death. They want us to refer all the complications to Medical colleges. But unnecessary referral is never comfortable for the patient.'

The nearest medical college is about 60-80 kilometres and one and a half hours away from this CHC. The '108' ambulance is readily available but the patient is shifted from one ambulance to another midway. This is because an ambulance as a norm does not travel long distances from its station. Sometimes, a lot of time is lost in such co-ordination and shifting. Thus the CHC obstetrician has to be doubly sure before referring the case to higher centre.

5.2.3 Obstetrician at Sub-district hospital Chowari, Chamba, Himachal Pradesh

The obstetrician was on leave and thus we could not interview her. However we interviewed the Superintendent of the hospital to know about the obstetric referral facilities. He told that the facility was the only referral centre in the valley and was usually busy. The obstetrician had lot of responsibilities. She managed both the obstetric and gynaecology cases in the OPD, supervised deliveries, and conducted a few caesarean deliveries. She was on duty almost 24X7. She also had to conduct one or two night duties where she had to also manage the emergency and wards. At any given time at least one staff nurse was exclusively posted for the labour room. They also had support from a trained TBA.

'*We try to provide her (obstetrician) as much support as we can but everybody relies on her for obstetric cases even when she is not on duty.'*

The centre did not have a blood bank or blood storage thus they had to refer many severe anaemia and haemorrhage cases. In absence of blood, they couldn't operate on complicated obstetric cases. The health centre had several referrals from peripheral centres but they did not have an established referral communication with lower or higher level centres.

'*She can only manage some medical complications, provide stabilising care and timely referral. I have confidence in her decision on patient care and I don't get much involved.'*

5.3 Team work and communication between facilities for efficient referral

5.3.1 Civil hospital Kunihar, Himachal Pradesh

Three doctors and six staff nurses posted in the hospital of which only one doctor and two staff nurses had received training for the SBA. The labour room was recently upgraded and had all the equipment required. We were able to interview the doctor on duty (not SBA trained). She along with one staff nurse managed the emergency, labour room and other admitted cases in the ward during her evening and night shift.

'*We have a good team of three doctors and one of them is SBA trained. I have brushed up my skills and knowledge while working with him. He is not an obstetrician but can manage many complication cases by himself. I often call him if I am in doubt about any patient.'*

She mentioned that the hospital had received good support from the district administration. Recently the labour room was re-furbished and they were encouraged to conduct more deliveries. She praised the obstetrician at the referral centre and his accessibility.

'*The obstetrician in District hospital is very approachable. In case of any complication, we can directly call him for guidance. He helps us decide how to manage the case at our hospital or if to refer the case to Solan. We, as a practice, call him when we are referring a serious case so that the arrangements are ready there.'*

'I am thankful for the staff nurses we have. Although we could have done better if there were two nurses on duty for the night… so that one could be in the ward all the time and other could help in managing emergencies. With the help of the relatives, we manage both the ward and emergencies.'

About '108' ambulance system she mentioned that the '108' ambulance was stationed in their compound. It helped to immediately transfer the cases when required. The ambulance technician also gave a helping hand in stabilising the in-referred cases. The '108' had proven helpful for the patients in this hospital.

5.3.2 Civil hospital Kandaghat, Solan, Himachal Pradesh

The doctor on duty had received SBA training and was supported by a good team of doctors and nurses. They also had an ART centre which catered to HIV positive pregnant women. It was one of the centres where most HIV positive pregnant women of the region delivered. The patient care systems established at his hospital streamlined the work for all. He attributed it to the efficient and supportive team at the hospital and adherence to the guidelines. The doctor also expressed harmony with the obstetrician at the referral centre (District hospital Solan).

'*We face no referral issues. In case of hard to manage complications, we seek advice from him (obstetrician at referral centre) directly. It often avoids unnecessary referrals. And when we have to refer, we provide the advised stabilising care and then transfer.'*

The doctor stated that in their hospital they did not face any shortage of equipment or drugs. They used government schemes like *Janani Shishu Suraksha Karyakaram* efficiently for the poor women for drugs and other support. However the doctor did state that they received many unnecessary and delayed referrals from PHCs and CHCs. He suggested that identifying and strengthening a few PHCs and CHCs could rationally redistribute the work load. Otherwise, the patient is the one who suffers.

5.3.3 Senior Public Health Officer (SPHO) at CHC Gurazala, Guntur, Andhra Pradesh

The Senior Public Health Officer (SPHO) is a doctor who supervises a few PHCs. This had good communication and linkages with the PHC doctors, CHC doctors and a few doctors at the District hospital. He coordinated between the PHC doctors and CHC obstetrician so that the women with severe complication or emergency were managed well. He facilitated the care to be provided pre-referral and en-route, and helped to decide about place of referral. He ensured that facilities and obstetrician were available to attend the patient at the referral CHC or hospital.

ANNEX VB: GENERAL OBSERVATIONS ABOUT OBSTETRIC CARE AND REFERRALS FOR PREGNANT WOMEN IN THE STUDY STATES

We present here our observations for both the states about the quality of obstetric care and referral of pregnant women.

5.1 Himachal Pradesh

A delivery point is referred to any centre that provides birthing care or basic emergency obstetric care or comprehensive emergency obstetric care. Delivery points are distributed in such a manner that no large geographic areas were left without one. We observed that about half the CHCs and only a very few PHCs were designated as delivery points. The delivery points had very large populations to cater. ANMs were promoted to assist low-risk deliveries in the SHCs in hard to reach areas.

1. ANC check-up across all the PHCs and CHCs and few Civil hospitals were primarily done by the ANM supervisors. Only the women with complications or those referred were attended by the doctor. At SHCs, ANMs conducted ANC checkups and house to house counselling. ANMs encouraged the pregnant women to get check up by a doctor at PHC atleast once, and in case of high-risk or complication, checkup by an obstetrician atleast once.
2. Two hospitals (Regional hospital Chamba and Solan) had established a system to provide access to USGs and specific lab tests on referral request. While others (such as CH Nalagarh) required re-registrations and re-filling of forms by the referred pregnant women.
3. Experienced ANMs assisted deliveries at home if any patient could not travel to the health centre. One such ANM appreciated the previous doctor of the PHC who taught ANMs to assist in a delivery and manage mild complications. New doctor did not support ANMs to conduct deliveries at SHC or imminent delivery at home.
4. We visited a model SHC which assisted upto 20-30 deliveries per month, solely managed by an ANM with the help of a trained TBA. The ANM here had a good reputation with her clients. In the interview we found that she was motivated to serve, was confident and strictly followed the guidelines. She did not believe in the over medicalisation of delivery care. In the past she had persuaded health system

for setting up a basic birthing centre in her SHC, which she was successful in doing. She was much appreciated by the system and was provided with regular supplies.

5. Staff nurses were reluctant to take responsibility and manage a delivery case by themselves. They needed strong motivation and decision making support from the doctor.
6. Many staff nurses did not know about the basic management of high-risk or complications in pregnancy. Staff nurses were dependent on doctor even for stabilising care to be provided during an obstetric emergency.
7. Doctors at PHCs were busy in school health visits, meetings at the block level, and visited district headquarters for other administrative and financial reasons. Even after our informed visits, doctors were not found in 3 PHCs and we had to wait or revisit at their convenient time. In one such PHC, in the absence of the doctor, we observed that the lab technician managed outpatients and dispensed the medicines from the pharmacy.
8. Doctors at PHCs (usually one doctor/PHC) have several roles during the day. At night, they are on call and physical presence in the PHC is not expected by the system. But the community expects her/him all times, especially if the PHC is a designated delivery.
9. Doctors at PHCs felt desolate and reported resource constraints, especially in interior rural and tribal areas. They complained about lack of moral support and recognition from the system. Lodging arrangements for doctors in the remote areas were abysmal. Female doctors and nurses, even in towns, were concerned about security during nights.
10. Even the efficient doctors at PHCs were not rewarded or supported. Instead, they are discouraged to assist any obstetric high-risk pregnancy and in some instances even low-risk pregnant case.
11. An obstetrician in a health centre with no regular blood storage/bank or OT facility is underutilised.
12. Being a single obstetrician in a moderate to high load hospital is a 24X7X365 job. All staff and other fellow doctors rely on the obstetrician for key decisions. When obstetrician is off duty or on leave, others (doctors and nurses) are unable to manage complications and thus refer such cases.

13. Some doctors in CHC and Sub-district facility were not SBA trained, however, they were required to supervise nurses in labour room, especially during night duties. These doctors refer pregnant women even with mild complications.
14. Most doctors across different levels of care did not communicate with each other and thus there were no collaborative efforts for better patient management. Doctors at PHCs and CHCs feel that the referrals are not accepted or appropriately managed at the higher centre.
15. The referral between facilities was efficient if there was team work within the referring centre and communication with the obstetrician at the referral centre. This was observed in Solan district of Himachal Pradesh.
16. Most health centres maintained out-referral registers. Few hospitals had the referral slips attached to the labour room register for in-referral cases.
17. All health staff reported that many patients refused to comply with referral advice. Most of the time it required strong counselling to convince them to go to next level of care. Patients usually desire care at the first stop itself.
18. '108' ambulance service was readily available except for few complaints about getting approval from the '108' call centre doctor for inter-facility transfers.
19. Patients preferred to wait for '108' ambulance than using their own transport or taxi. The distances were large and they trusted the ambulance for en-route care.

Other observations from PHCs that were not delivery points-

20. In atleast three centres (PHC Jogohon, PHC Pukhari, and CH Chail), deliveries were assisted in the past but not at the time of the survey. In one PHC, the doctor was an AYUSH doctor who was in service for more than 10 years but was not trained for SBA. In other two centres, only one doctor and staff nurse were posted who could not manage any case beyond 4 pm.
21. Skilled and experienced nurses posted under a non-SBA trained doctor at a non-delivery point is also a waste of resource. Such nurse although willing to work do not want to own the sole responsibility of managing a woman in labour.
22. One of the doctors stated that there is political interference in posting of the doctor and even nurses. Thus there is an imbalance in postings and the areas with predominant supporters of opposition parties suffer.

5.2 Andhra Pradesh and Telangana

1. All the PHCs were suggested to provide delivery care however only 24X7 PHCs were providing it. All CHCs were providing BEmOC if an obstetrician was available. Only very few provided the caesarean facility. Sub-district hospitals were ugraded to provide CEmOC and referral services and were linked with blood banks.
2. There were no established systems for access to USGs and specific lab tests. Most doctors advised the relevant and necessary tests from nearby private lab facilities.
3. Deliveries were not promoted at SHC except in few tribal pockets.
4. At PHCs, nurses provided antenatal care to all, and delivery care for low-risk pregnant women. Young Staff nurses at PHCs were confident and enthusiastic. However, the nurses depended on the doctor for management of any complication or high-risk, and decision for a referral. Many nurses did not know about the basic management of high-risk or complications in pregnancy. On several occasions, doctors were in the field and nurses had to manage the centre by themselves. At many PHCs, only two nurses were posted who did 12 hours duties alternately.
5. The staff nurses and doctors at PHCs rarely provided pre-referral stabilising care. The '108' ambulance technician was observed to provide en-route care after consultation with the call centre doctor.
6. Staff nurses at PHC had absolutely no options for meeting and learning from other nurses or seniors, or consult anyone in absence of the PHC doctor.
7. Most doctors across different levels of care did not communicate with each other and thus there were no collaborative efforts.
8. Except in one CHC area, where the SPHO coordinated between the PHC doctors and CHC obstetrician so that the women with severe complication or emergency were managed well. He facilitated the care to be provided pre-referral and en-route, and helped to decide about place of referral. He ensured that services and obstetrician were available to attend the patient at the referral CHC or hospital.
9. Doctors complained about the absence of moral support and recognition from the system. They mentioned that, since maternal death review program was introduced in the state there has been a tendency to blame the lower level doctors and staff.

10. The obstetricians were irrationally placed and were not utilised to their ability. An obstetrician was posted at a PHC and was called at CHC for caesareans when required. She had to manage between two centres and her work at PHC suffered. She could have been posted at CHC. On the other hand the obstetricians at CHCs were not entrusted to manage complications. They were instructed to refer all the complication cases.
11. At another CHC, the staff nurse mentioned that the obstetrician did not attend the cases at all. Obstetrician attended cases at the private nursing home owned by her husband.
12. Other CHCs where obstetrician was not available, only BEmOC care was provided despite the availability of operation theatre and equipment. The doctors in such CHCs were specialists like Paediatrician, Anaesthesiologist, Surgeons, Dentists or others. One of these specialists mentioned that they no longer remembered the basics of obstetric care. During their duties, the deliveries were managed by staff nurses and these doctors just monitored the stability of mother and child. In case of any complication, they did not know how to manage thus they referred the case immediately. One of the doctors at a CHC in Vizianagram mentioned *that* it was not appropriate for the system to use them as general physicians.
13. One of the CHCs earlier had an obstetrician who provided comprehensive obstetric care but she was transferred to Sub-district hospital. There was no replacement obstetrician however the pregnant women continued to visit. Staff nurses managed most of the low-risk cases and women with slightest complication were immediately referred.
14. At one CHC, under NRHM, four staff nurses were posted to manage delivery cases but these nurses were utilised more for other wards. Only basic delivery services were provided to very few pregnant women.
15. The obstetrician at CHC and Sub-district hospital felt that the referrals by lower centres were all justified. They expressed that the staff at lower centres did not have skills and resources to manage any complications. They also mentioned that the staff from lower facilities should atleast stabilise the case before referral and should refer to appropriate centre.

16. The CHCs and Sub-district hospitals had blood storage facility but often had stock outs. Thus sometimes the women referred to these centres for blood transfusion, had to be re-referred to the district centre. This added to unnecessary delay in care.
17. All health staff reported that many patients refused to comply with referral advice. Most of the time it required a lot of counselling to convince patients/relatives to go to next level of care.
18. Only a few health centres maintained separate out-referral registers. Out-referrals were mostly mentioned in the labour room register. Referrals at the antenatal period were not documented. We did not find any in-referral registers/documentation.
19. The referring centre rarely followed the outcomes of the referred cases, nor did they receive any feedback from the referral centre. There was no forward communication or feedback mechanism.
20. The '108' ambulances were readily available except for few complaints about long distance inter-facility transfers. The client had to be shifted between two to three ambulances on long distance trips.
21. Patients from towns did not wait long for '108' ambulance if there was any complication. The '108' was the mainstay of travel for tribal and remote areas.

Two CHCs had their ambulances but these were not readily available. One CHC had only one driver who was available only during office hours. Other CHC hired a driver if required. The ambulances often did not have fuel and could be made available if the patient paid for fuel. The doctor told that they sometimes used *Janani Shishu Suraksha Karyakaram* funds for fuel. These ambulances did not have any life-saving equipment.

ANNEX VI: SEARCH STRATEGY FOR SYSTEMATIC REVIEW- 'EFFECTIVENESS OF TRANSPORT INTERVENTIONS ON EMERGENCY OBSTETRIC CARE IN INDIA.'

1. "referral and consultation"/ or gatekeeping/ or physician self-referral/ or remote consultation/ or secondary care/ or tertiary healthcare/

2. exp Transportation/

3. exp Transportation of Patients/

4. patient transfer/

5. exp transfer/

6. Ambulances/ or Air Ambulances/

7. time factors/

8. communication/

9. telecommunications/

10. exp telephone/

11. Satellite Communications/

12. electronic mail/ or *radio/ or *answering services/ or *cellular phone/ or *wireless technology/ or computer communication networks/

13. (phone* or telephone* or cellphone* or mobilephone* or radio*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

14. *Distance Perception/

15. exp Emergency Medical Service Communication Systems/

16. emergency medical services/ or emergency service, hospital/ or trauma centres/

17. emergency treatment/ or emergency nursing/ or exp maternal-child nursing/

18. Emergencies/

19. triage/

20. First Aid/

21. exp hospitalisation/ or *Critical Care/

22. delivery of healthcare/ or exp "quality of health care"/

23. Health Services Accessibility/

24. health communication/ or health education/ or consumer health-information/

25. referr*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

26. (referral adj2 pathway*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

27. ((birth or complication or emergency) adj2 prepare*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

28. (emergency adj1 (vehicle* or transport* or van* or car* or cycle* or bicycle* or ambulance*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

29. (emergenc* adj2 (respons* or referral*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

30. ((health or communit*) adj5 (work* or participant* or profession* or educat* or fund* or service*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

31. (transfer* or transport* or communication* or emergenc* or ambulance).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

32. (delay* or time* or distance*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

33. ((matern* or deliver*) adj3 (wait* or outreach or out-reach or home*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading

word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

34. ((train* or educat*) adj3 (matern* or health* or professional or doctor* or midwive* or midwife* or nurs*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

35. (fund* or financ* or cash or voucher* or incentive*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

36. ((transport* or transfer) adj2 cost*).mp.

37. or/1-36

38. pregnancy/ or labor, obstetric/ or exp pregnancy outcome/

39. exp Pregnancy Complications/

40. delivery, obstetric/ or extraction, obstetrical/ or labor, induced/

41. Obstetrics/

42. exp Obstetric Labor Complications/

43. maternal health services/ or perinatal care/ or postnatal care/ or prenatal care/

44. Maternal-Child Health Centres/ or *mobile health units/

45. Maternal Mortality/ or *fetal mortality/ or *infant mortality/ or *mortality, premature/ or *perinatal mortality/

46. (ante-natal or antenatal or pre-natal or prenatal or natal or ante-partum or antepartum or post-natal or postnatal or post-partum or postpartum).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

47. (peri-natal or perinatal).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

48. (labo?r or delivery or birth or childbirth).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol

supplementary concept word, rare disease supplementary concept word, unique identifier]

49. pregnan*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

50. ((maternal or neonat*) adj3 (morbidity or mortality or outcome*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

51. ((thirdstage or third-stage) adj1 labo?r).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

52. (BEmO?C or EmO?C or CEmO?C).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

53. ((highrisk* or high-risk*) adj2 (pregnan* or obstetric* or delivery or labo?r or birth or antenatal or ante-natal or perinatal or peri-natal or postnatal or post-natal)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

54. ((obstetric* or pregnan* or labo?r or birth or antenatal or ante-natal or perinatal or peri-natal or postnatal or post-natal or abortion) adj2 (complicat* or emergenc*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

55. (emergenc* adj2 obstetric*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

56. (obstetric adj3 care*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

57. (matern* adj2 (hospital or centre or health centre)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

58. or/38-57

59. India.mp. or India/

60. 37 and 58 and 59

61. limit 60 to (english language and humans and yr="1991 -Current")

ANNEX VII: PAPER 2: TRANSPORT OF PREGNANT WOMEN AND OBSTETRIC EMERGENCIES IN INDIA: AN ANALYSIS OF THE '108' AMBULANCE SERVICE SYSTEM DATA

London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
www.lshtm.ac.uk

Registry
T: +44(0)20 7299 4646
F: +44(0)20 7299 4656
E: registry@lshtm.ac.uk

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	SAMIKSHA SINGH
Principal Supervisor	PAT DOYLE
Thesis Title	REFERRAL SYSTEMS AND TRANSPORT FOR EMERGENCY OBSTETRIC CARE IN INDIA

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	BMC Pregnancy and Childbirth. 16:318		
When was the work published?	2016		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	No		
Have you retained the copyright for the work?*	**No**	Was the work subject to academic peer review?	**Yes**

If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.

SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	Choose an item.

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I planned and conducted the research, and wrote the manuscrpit first draft.

Student Signature: [redacted] **Date:** 19 September 2017

Supervisor Signature: [redacted] **Date:** 19 September 2017

Singh *et al. BMC Pregnancy and Childbirth* (2016) 16:318
DOI 10.1186/s12884-016-1113-7

BMC Pregnancy and Childbirth

RESEARCH ARTICLE Open Access

Transport of pregnant women and obstetric emergencies in India: an analysis of the '108' ambulance service system data

Samiksha Singh[1*], Pat Doyle[2], Oona M. R. Campbell[3], G. V. R. Rao[4] and G. V. S. Murthy[1,5]

Abstract

Background: The transport of pregnant women to an appropriate health facility plays a pivotal role in preventing maternal deaths. In India, state-run call-centre based ambulance systems ('108' and '102'), along with district-level Janani Express and local community-based innovations, provide transport services for pregnant women. We studied the role of '108' ambulance services in transporting pregnant women routinely and obstetric emergencies in India.

Methods: This study was an analysis of '108' ambulance call-centre data from six states for the year 2013–14. We estimated the number of expected pregnancies and obstetric complications for each state and calculated the proportions of these transported using '108'. The characteristics of the pregnant women transported, their obstetric complications, and the distance and travel-time for journeys made, are described for each state.

Results: The estimated proportion of pregnant women transported by '108' ambulance services ranged from 9.0 % in Chhattisgarh to 20.5 % in Himachal Pradesh. The '108' service transported an estimated 12.7 % of obstetric emergencies in Himachal Pradesh, 7.2 % in Gujarat and less than 3.5 % in other states. Women who used the service were more likely to be from rural backgrounds and from lower socio-economic strata of the population. Across states, the ambulance journeys traversed less than 10–11 km to reach 50 % of obstetric emergencies and less than 10–21 km to reach hospitals from the pick-up site. The overall time from the call to reaching the hospital was less than 2 h for 89 % to 98 % of obstetric emergencies in 5 states, although this percentage was 61 % in Himachal Pradesh. Inter-facility transfers ranged between 2.4 % –11.3 % of all '108' transports.

Conclusion: A small proportion of pregnant women and obstetric emergencies made use of '108' services. Community-based studies are required to study knowledge and preferences, and to assess the potential for increasing or rationalising the use of '108' services.

Keywords: Ambulance, Obstetric emergency, Obstetric complication, Pregnant women, Patient transport, Access, Maternity Services, Travel time

Background

Most maternal deaths could be prevented if women are assisted by skilled attendants at birth and those experiencing complications could reach quality emergency obstetric care (EmOC) in a timely manner [1]. It is estimated that at least 15 % of all pregnancies will encounter complications and 7 % will be serious enough to require referral to a higher level of care [1]. In many countries with high maternal mortality the lack of transport, poor communication, high cost and geographical barriers can lead to fatal delays in reaching life-saving care [2]. Delays in reaching basic delivery care and EmOC also contribute to maternal morbidity in the form of medical complications, obstetric fistula, disability, and depression, as well as perinatal mortality [2]. Making transport freely available to pregnant women is thus a key intervention to reduce such delays [3, 4]. Many such interventions have proven successful and these include adequate birth planning, availability and

* Correspondence: samiksha.singh@iiphh.org
[1]Indian Institute of Public Health-Hyderabad, Public Health Foundation of India, Hyderabad, Telangana, India
Full list of author information is available at the end of the article

low costs for transport, along with effective communication systems [5].

In 2013, India had an estimated institutional delivery rate of 82.7 % [6], a maternal mortality ratio of 167 per 100,000 live births [7] and early neo-natal mortality rate of 28 per 1000 live births [7]. Although India has shown substantial improvement in these indicators in the last decade [8–10], but it has failed in achieving MDG-4 and MDG-5 targets for the reduction in child and maternal mortality by 2015 [11, 12]. Failure to meet these targets is explained by lack of access to appropriate specialist care, poor quality of care and poor systems of transport for high-risk pregnancies or obstetric complications to EmOC- contributing to the failure of timely access [13]. Studies in India reveal that about one-third to one-half of reported maternal deaths occurred at home or on the way to care [14–16].

Since 2002, the government has implemented many schemes and interventions to improve basic transport and ambulances for pregnant women under the Reproductive and Child Health-2 Program and the National Rural Health Mission [17]. These include the Janani Suraksha Yojana- a cash transfer scheme that covers some travel costs; regional voucher schemes; state run call centre based ambulance systems ('108' and '102'); and decentralised district level public private partnerships such as Janani Express and local community-based innovations to provide basic transport services [18, 19]. In addition, the Janani Shishu Suraksha Karyakaram scheme works mainly through the '102' ambulance system to provide reverse transport from a facility to home for the poor [20].

The '108' call centre based ambulance system is a free of cost emergency response system, known to be one of the largest public private partnership (PPP) initiatives across India functioning in 20 states and two union territories. Although it is designed primarily to attend to patients who are critically ill and, victims of trauma and accidents, state governments consider '108' ambulance services to be the mainstay of transport for pregnant women in both normal labour and emergency [21]. The service is provided in partnership with three private institutes: the GVK-Emergency Medicine Research Institute (GVK-EMRI) which serves in 15 states and two union territories; the Ziqitza Health Care Limited in four states; and the Bharat Vikas Group Limited in one state [21].

The role of the '108' ambulance service in reducing maternal mortality and severe morbidity is currently unknown. The aim of this research is to contribute to knowledge about the use of the '108' ambulance service for pregnant women in India. The objectives of the research were to (i) describe the characteristics of pregnant women who requested '108' assistance, (ii) to estimate the proportion of all pregnant women and obstetric emergencies who made use of the '108' service, (iii) to describe the characteristics of the women transported, their obstetric complications, and the journeys made, for each state.

Methods

Context

GVK-EMRI, the first and largest service provider of '108' was chosen for this study. It started operations in August 2005 in Andhra Pradesh and spread to other states. The proportion of all '108' transports that were pregnancy related increased from 2 % in 2006 to 21 % in 2009 in Andhra Pradesh [22]. Across India also, this rose dramatically from 2 % in 2005–06 to 41.2 % in 2014–15 [23].

According to the operational guidelines of the '108' ambulance service, there should be about one ambulance per 100,000 population. The ambulances should be well equipped and accompanied by a trained Emergency Medicine Technician (EMT) who could provide pre-hospital care before transfer. Pregnant women can be provided with intravenous fluids and oxygen if required, and magnesium-sulphate and oxytocin after consulting the call-centre based medical officer. In case of imminent childbirth, the EMT can assist the delivery at home or en-route, and transfer the mother and child to the nearest health facility [24]. In the '108' system every pregnancy is a priority and there is no triage for emergencies in pregnancy or the postpartum period. Ambulances are dispatched to only about 8 % of general health care calls (87 % of the remaining calls are irrelevant or mischief calls) compared to nearly 95 % or more for pregnancy related calls [25].

As a policy '108' ambulances transport clients to the nearest appropriate public health institution. If there is none close to the pick-up site then they transport the client to the nearest private hospital that is empanelled under the '108' emergency response system. The patient's choice is also considered while making the decision. The '108' ambulance service aims to reach patients/sites within 20 min in urban, and within 40 min in rural, areas and reach the nearest health facility within 20 min following pick-up [26].

Study design

This study is a cross-sectional analysis of 108 ambulance records from six states for one year. The numbers, proportions, and characteristics of pregnant women and obstetric emergencies transported by the '108' ambulance service are described.

Obstetric emergency, for this study, is defined as any life-threatening medical complication related to pregnancy or a medical condition complicating pregnancy-

during pregnancy, labour or child-birth, or within 42 days of termination of pregnancy. A pregnancy-related call is defined as any call from, or for a pregnant woman, in labour or in the post-partum period for antenatal care, abortion related care, labour pains, child-birth, post-birth care in the postpartum period, or any complication in these periods.

Study population

Pregnant women who called '108' between 1st April 2013 and 31st March 2014 in five states where GVK-EMRI had been fully functional for more than 3 years were included in this analysis. One state was selected randomly from North, South, Central, West and East of India. These were Himachal Pradesh, (undivided) Andhra Pradesh, Chhattisgarh, Gujarat, and Assam. Andhra Pradesh was subsequently officially divided into Telangana and (new) Andhra Pradesh in June 2014. During analysis, data were segregated and analysed separately for Telangana and (new) Andhra Pradesh and thus in the rest of the paper we describe six states.

Obtaining data

GVK-EMRI emergency response centre records basic information about the client when he/she calls '108' for an ambulance. Later, after examination by the EMT and once the case is transported, the EMT reports to the emergency response centre to provide more information on social-economic status, clinical condition, and treatment provided en-route, and details of journeys undertaken.

Official permission to use the data was obtained from GVK-EMRI and ethical approval for the study was obtained from Indian Institute of Public Health-Hyderabad and the London School of Hygiene and Tropical Medicine. Anonymised information on '108' calls from 1st April 2013 to 31st March 2014 was obtained from the GVK-EMRI emergency response centre database. No personal identifiers were recorded. Data were linked with the incident/case id recorded by the call centre. Variables of interest for the secondary data analysis were: type of call; ambulance assigned or not; assigned ambulance used or not; type of emergency; age; social class; economic class; region; time of call; day of call; time taken by ambulance to reach the client; time taken to reach the health facility; distance travelled; inter-facility transfers; and mortality.

Data management

Data were extracted from a central database onto Excel sheets, and analysis was done using STATA 13.0. Data were inspected before use to assess consistency, range, and missing data. Any gross issue related to the quality of records was noted. Where appropriate, variables were recoded. About 1 –5 % data were missing in most of the variables. However for social-class and economic status, 10 –30 % of the data was missing. There were a few data inconsistencies. Some possible wrong entries were noted in the time and distance variables but these constituted less than 0.5 % of all data. These records were excluded from analyses. The states included in the study also transported neonates in the post-partum period, and in Telangana and (new) Andhra Pradesh, mothers and newborns were also transported back from hospital to home. This information was extracted from 3 variables and text remarks within the dataset and these cases were excluded from analysis.

The '108' annual reports also classify delivery by EMT at home or in the ambulance, suicide/ injury/ accidents and category 'others' as emergencies. Deliveries assisted by EMTs did not have information on whether these were normal delivery cases or had complications. EMTs were trained only to handle normal deliveries. We were not sure whether suicide/ injury/ accidents were classified as medical conditions due to pregnancy, or complicated by pregnancy or otherwise, as there was no further information on these in the EMT logs. Since we could not reliably classify these cases as obstetric emergences we excluded them from this analysis.

Analysis

Characteristics of state populations and pregnant women who requested 108 assistance

Socio-demographic information for the populations in six states were collated from the Census, the Sample Registration System (SRS), District Level Household Survey (DLHS), and Annual Health Survey (AHS), using information as close to the study period dates as possible. Information on pregnancy related calls to '108' were estimated from '108'call centre data (2013–2014) and presented by state. This information included whether or not the ambulance was assigned, or used. The characteristics of the callers were compared to the characteristics of the state populations.

Estimation of proportions of all pregnant women and obstetric emergencies who used the 108 service within states

For each state, the number of pregnancies expected in the study period was estimated as [population (rural) X crude birth rate (rural) X 1.1 × 1000] + [population (urban) X crude birth rate (urban) X 1.1 × 1000]. The population data were obtained from the 2011 census and the crude birth rates from the Sample Registration System 2013. The multiplier 1.1 was used to account for an estimated 10 % of the pregnancies which may have ended in abortions or intra-uterine deaths.

The number of obstetric emergencies expected in the study period was estimated as [estimated no. of pregnancies X 0.15], using 15 % as the expected overall prevalence of direct obstetric emergencies.

The numbers of pregnant women transported by '108' as recorded in the call-centre database were compared with these estimated numbers for each state.

Characteristics of the women transported, their obstetric complications, and the journeys made, for each state

Socio-economic information on women who were transported using 108 ambulances was collated and presented by state. Clinical information on their obstetric emergencies, and the journeys taken by women experiencing obstetric emergencies, was also collated and presented according to state.

Results

As background information, the characteristics of states with respect to population size, fertility and mortality were compiled (Table 1). Chhattisgarh and Assam are the poor performing states in maternal and child health. In Chhattisgarh, '108' worked to full capacity for transporting pregnant women until September 2013 when '102' ambulance service took over and the transports by '108' reduced to 1/10th of the previous transfers, in October 2013 – March 2014.

Pregnancy related calls to '108'

A total of 621,640 pregnancy related calls were attended by the '108' call centre in five states from April 2013 to March 2014. Data regarding these was not available from state of Assam. A higher proportion of calls were from rural than urban areas in all the states except Himachal Pradesh, even higher than expected from population proportions. For example, the rural population in Chattisgarh and Assam were 76.7 % and 57.4 % respectively (Table 1) while the proportion of '108' service calls from rural areas in these two states were 92.8 % and 88.5 % respectively (Table 1).

Table 1 Demographic characteristics and use of '108' ambulance in different states

	Telangana	Andhra Pradesh	Himachal Pradesh	Chhattisgarh	Gujarat	Assam
Demographic Characteristics						
Total Population[a]	35,193,978	49,386,799	6,856,509	25,540,196	60,383,628	31,169,272
Rural/tribal	61.3 %	70.4 %	90.0 %	76.8 %	57.4 %	85.9 %
Urban	38.7 %	29.6 %	10.0 %	23.2 %	42.6 %	14.1 %
Scheduled caste[a]	15.4 %	17.1 %	25.2 %	12.8 %	6.8 %	7.2 %
Scheduled tribe[a]	9.3 %	5.33 %	5.7 %	30.6 %	14.8 %	12.5 %
Crude birth rate per 1000 population[b]	17.5		16.2	24.5	21.1	22.5
Rural/tribal	17.9		16.7	26.0	22.5	23.7
Urban	16.6		11.0	18.0	18.7	15.6
Institutional delivery rate(2012–13)[c]	94.1 %	88.5 %	77.8 %	39.5 %	-awaited-	65.9 %
MMR(2011–13)[b]	92		-	244	112	300
NMR(2012–13)[b]	25		25	31	26	27
No. of Ambulances under '108'[d]	802		171	240	506	380
Pregnancy-related 108 Calls- April 2013 to March 2014						
Pregnancy related calls to '108'	122,619	172,076	25,016	65,243[e]	261,702	Not available
Area						
Rural/tribal	74.0 %	76.5 %	80.9 %	92.8 %	88.5 %	Not available
Urban	25.9 %	23.3 %	6.2 %	7.2 %	11.5 %	
Missing	0.2 %	0.2 %	12.9 %	0.0 %	0.0 %	
Use of ambulance						
Ambulance used	90.0 %	89.8 %	99.8 %	95.2 %	99.4 %	Not available
Ambulance not used	7.8 %	8.2 %	0.2 %	3.2 %	0.0 %	
Ambulance not assigned	2.2 %	2.0 %	0.0 %	1.6 %	0.6 %	

Source- [a]Census 2011
[b]Sample Registration System 2013- Separate data for Telangana and Andhra Pradesh not available
[c]DLHS (2012–13) / AHS (2011–12)
[d]GVK-EMRI annual report for period April 2013- March 2014
[e]In Chhattisgarh '102' ambulance service took over from October 2013 – March 2014

Ambulances were assigned for more than 98 % of the pregnancy-related calls overall. Table 1 shows that the proportion of calls resulting in an ambulance not being assigned, and an ambulance not being used despite being assigned, was highest in Telangana and (new) Andhra Pradesh. The proportion of callers who were not assigned an ambulance did not vary between rural and urban populations, or between and non-IFT calls (data not shown). The proportion who did not use an ambulance (despite being assigned) was higher amongst urban (4.5 %) compared to rural (3.1 %) populations and in IFT (6.1 %) compared to non-IFT (3.9 %) callers.

Estimated proportions of pregnant women, and obstetric emergencies, transported by '108'

Table 2 presents estimates of the proportion of pregnant women, and obstetric emergencies, transported using '108'. In total 757,697 pregnant women were transferred to hospitals using '108' ambulances in the study year, which was 16.5 % of the estimated pregnancies for all the study states. The estimated proportion of pregnant women transported by '108' ranged from 9.0 % in Chhattisgarh to 20.5 % in Himachal Pradesh.

Overall, 4.7 % of expected obstetric emergencies (based on 15 % of all pregnancies in the population) were transported across the States. The highest estimated proportion of obstetric emergencies transported was in Himachal Pradesh (12.7 %) and Gujarat (7.2 %) (Table 2). For other states the estimated proportion of obstetric emergencies transported was 3.5 % or less.

Characteristics of pregnant women transported by '108'

Table 3 describes the characteristics of pregnant women transported by the '108' service. The majority were 20–35 years old. A higher proportion of users belonged to scheduled caste and scheduled tribes compared to the census population in all the states, except Chhattisgarh and Assam. Almost all the users in Telangana and Andhra Pradesh, 85 % in Assam, and about three fifths in Himachal Pradesh and Gujarat were classified as belonging to below the poverty line category. Between 2.4 % of pregnant women transported by '108' ambulances in Gujarat, and 11.3 % in Himachal Pradesh, were referred and transported from a health institution. Less than 5 % deliveries happened at the pick-up site or in the ambulance en-route across the states. Between 2.7 % and 9.3 % of transported pregnant women had an obstetric emergency in the study states and the majority used '108' ambulances for normal labour pains or other reasons.

Obstetric emergencies transported by '108'

Table 4 presents further detail on the type of obstetric emergency. The most common obstetric emergency was abnormal presentation of the foetus (Telangana, Andhra Pradesh and Gujarat), bleeding in pregnancy (Himachal Pradesh and Assam), and medical conditions complicating pregnancy in Chhattisgarh. Among pregnant women transported for obstetric emergency, the proportion of inter-facility transfers ranged from 4.5 % in Gujarat to 25.5 % in Himachal Pradesh.

Distances travelled and time taken by '108' ambulances to transfer pregnant women with emergency are shown in Table 4 and Fig. 1. Ambulances travelled less than 10–11 km to reach half the pregnant women with emergency across all the study states. However median distances to the health centre were between 10 km in Chhattisgarh to 21 km in the states of Telangana and Andhra Pradesh. The time taken in travel to reach the pregnant women, and to the hospital, was lowest in Chhattisgarh and Gujarat. Although distances in Himachal Pradesh were not the highest, the travel time was the longest compared to the other states. The median time from call to '108' and reaching a hospital ranged from 60 min to 90 min in all the states and the 75th percentile in Himachal Pradesh was high at 150 min. The median distances and times travelled by pregnant women with emergencies were up to 5–10 kms further and 10–20 min longer than pregnant women without emergency (data not shown).

Discussion

The '108' scheme was the only large publically financed scheme and the main free transport of pregnant women

Table 2 Estimated proportion of pregnant women transported to hospitals by '108' April 2013 to March 2014

	Telangana	Andhra Pradesh	Himachal Pradesh	Chhattisgarh[c]	Gujarat	Assam
Estimated number of pregnancies in state[a]	673,508	950,696	121,638	678,217	1,387,021	773,480
-Transported by '108'	105,381 (15.7 %)	147,374 (15.5 %)	24,923 (20.5 %)	60,810 (9.0 %)	270,071 (19.5 %)	149,138 (19.3 %)
Estimated number of obstetric emergencies in state[b]	101,026	142,730	18,246	101,733	208,053	116,022
-Transported by '108'	3,570 (3.5 %)	4,837 (3.4 %)	2,316 (12.7 %)	2,660 (2.6 %)	15,065 (7.2 %)	4,040 (3.5 %)

[a][population (rural) X crude birth rate (rural) X 1.1 × 1000] + [population (urban) X crude birth rate (urban) X 1.1 × 1000]
[b]Estimated no. of pregnancies X 0.15
[c]In Chhattisgarh '102' ambulance service took over from October 2013 – March 2014

Table 3 Characteristics of pregnant women transported to hospitals by '108' April 2013 to March 2014

	Telangana N = 105,381	Andhra Pradesh N = 147,374	Himachal Pradesh N = 24,923	Chhattisgarh N = 60,810	Gujarat N = 270,071	Assam N = 149,138
Age, %						
< 20 years	3.6	4.9	5.5	5.8	1.7	8.1
20-35 years	95.6	94.2	91.2	92.7	79.7	87.6
> 35 years	0.5	0.6	1.5	1.0	1.0	0.8
missing	0.3	0.3	1.8	0.5	17.6	3.5
Social caste, %						
General caste	5.2	10.8	29.6	1.6	12.8	3.3
Other backward	43.2	43.5	9.4	20.3	35.0	16.7
Scheduled caste	33.8	33.9	32.7	6.8	11.0	8.8
Scheduled tribe	17.2	11.0	5.9	17.5	41.0	11.7
DK/ missing	0.7	0.7	22.4	53.8	0.1	59.4
Economic class, %						
BPL	98.3	98.5	57.2	4.6	55.7	85.0
Others	0.5	0.4	28.8	0.1	44.0	10.6
DK/ missing	1.2	1.1	14.0	95.3	0.2	4.4
Area, %						
Rural/tribal	76.9	78.1	80.9	92.7	88.6	Not available
Urban	23.1	21.7	6.3	7.3	11.4	
Missing	0.1	0.2	12.8	0.0	0.0	
Type of transfer, %						
IFT	8.7	9.9	11.3	3.2	2.4	Not available
Non-IFT	91.4	90.1	88.7	96.8	97.6	
Delivery en-route, %						
At pick up site	0.6	0.7	1.5	2.7	1.7	1.7
In ambulance	0.7	0.7	3.3	1.5	0.9	1.8
Type of hospital, %						
Public	72.8	71.4	94.7	88.2	70.1	Not available
Private	13.7	16.0	2.5	3.2	27.4	
Missing	13.5	12.7	2.8	8.6	2.5	
Obstetric emergency, %	3.4	3.3	9.3	4.4	5.6	2.7

BPL Below poverty line; *IFT* Inter-facility transfer, *DK* Don't know

in these states for the period of study. Some women did not use '108' ambulance despite being provided one. These women would have either delivered or left using other means of transport before '108' ambulance reached the location. The calls that were not assigned ambulance was a very small proportion of all calls to '108'. A '108' ambulance is not provided to a pregnant women if the ambulance of that catchment area is on a journey to transfer another client.

The analysis reported here estimated that between 9.0 % and 20.5 % of pregnant women in the population in 2013–2014 were transported by '108'. This suggests that '108' was the choice of transport for less than one-tenth to one-fifth of pregnant women. However, pregnant '108' users were more likely to be from below the poverty line and scheduled caste and tribes compared to the general population, signifying that relatively more needy women were utilising '108' when pregnant, compared to the more well off in most states. The DLHS-4 survey in 2012–13 found that the proportion of institutional deliveries was 94.1 % in Telangana, 88.5 % in Andhra Pradesh and 77.8 % in Himachal Pradesh [27–29]. Of the institutional deliveries, it was reported that 7.4 % in Telangana, 12 % in Andhra Pradesh and 20.8 % in Himachal Pradesh used an ambulance for transport to hospital [27–29]. These figures are broadly in line with the findings reported here. Between 4.2 % and 10.7 % of home deliveries stated non-availability of

Table 4 Characteristics of obstetric emergencies transported by '108' April 2013 to March 2014

	Telangana, N = 3,570	Andhra Pradesh, N = 4,837	Himachal Pradesh, N = 2,316	Chhattisgarh N = 2,660	Gujarat N = 15,065	Assam N = 4,040
Area, (%)						
Rural/tribal	2580 (72.3)	3646 (75.4)	1789 (77.3)	2436 (91.6)	12974 (86.1)	Not available
Urban	985 (27.6)	1177 (24.3)	270 (11.7)	224 (8.4)	2091 (13.9)	-
Missing	5 (0.1)	14 (0.3)	257 (11.1)	0 (0.0)	0 (0.0)	-
Type of transfer, (%)						
IFT	531 (14.9)	784 (16.2)	591 (25.5)	348 (13.1)	681 (4.5)	Not available
Non-IFT	3039 (85.1)	4053 (2.8)	1725 (74.5)	2312 (86.9)	14384 (95.5)	-
Type of complication, %						
Abortion	137 (3.8)	301 (6.2)	292 (12.6)	113 (4.3)	412 (2.7)	288 (7.1)
Abnormal						
Presentation	1156 (32.4)	1520 (31.4)	115 (5.0)	712 (26.8)	8369 (55.6)	788 (19.5)
Bleeding in pregnancy	596 (16.7)	818 (16.9)	1339 (57.8)	133 (5.0)	2458 (16.3)	1782 (44.1)
Eclampsia/ convulsion	255 (7.1)	370 (7.7)	59 (2.6)	65 (2.4)	220 (1.5)	396 (9.8)
Fever	93 (2.6)	136 (2.8)	0 (0.0)	47 (1.8)	136 (0.9)	0 (0.0)
Foetal loss	71 (2.0)	106 (2.2)	41 (1.8)	227 (8.5)	62 (0.4)	27 (0.7)
Medical condition						
complicating pregnancy	733 (20.5)	774 (16.0)	356 (15.4)	1214 (45.6)	1011 (6.7)	36 (0.9)
Previous caesarean	291 (8.2)	481 (9.9)	65 (2.8)	127 (4.8)	1219 (8.1)	416 (10.3)
Precious pregnancy	238 (6.7)	331 (6.8)	49 (2.1)	22 (0.8)	1178 (7.8)	307 (7.6)
Distance call to site,[a] Kilometres ; Median (IQR)	10 (3–18)	10 (3–18)	9 (1–17)	8 (1–17)	11 (6–17)	Not available
Distance site to hospital,[a] Kilometers; Median (IQR)	21 (11–32)	21 (12–31)	17 (7–30)	10 (4–20)	15 (9–23)	Not available
Time call to site,[a] minutes ; Median (IQR)	23 (12–35)	24 (12–37)	32 (15–56)	23 (12–37)	23 (15–33)	Not available
Time site to hospital,[a] minutes ; Median (IQR)	38 (23–56)	37 (23–55)	60 (35–95)	25 (14–43)	24 (15–36)	Not available
Time call to hospital,[a] minutes ; Median (IQR)	73 (54–98)	75 (55–97)	91 (63–146)	60 (41–86)	57 (43–75)	Not available

IFT Inter-facility transfer, *IQR* Interquartile range
[a]*N* varies- excludes deliveries by EMT that were not transported or missing values

transport as the reason for not delivering in any health institution [27–29].

The number of pregnant women transported by '108' in (undivided) Andhra Pradesh increased from 65,009 in 2007–08 to 323,495 in 2009–10 [30] and continued to be approximately 300,000 till 2013–14. Simultaneously in (undivided) Andhra Pradesh, the proportion of pregnant women transported by '108' who had any complication or emergency reduced from 40 % in 2007–08 [22] to 3.3 %, in 2013–14. This is encouraging for the scheme since, as desired, more pregnant women were accepting '108' ambulance services for normal deliveries than just for obstetric emergencies.

While the transport services may transport all pregnant women, irrespective of the high-risk or actual complication, the success of such a system should be measured by the proportion of all pregnant women with complications who were transported to an appropriate referral level [19]. In our study, the estimated proportion of obstetric emergencies in the population transported by '108' was 12.7 % in Himachal Pradesh, 7.2 % in Gujarat and less than 3.5 % in other states. It is thus unlikely that 108 ambulances had significant impact on maternal death due to complications in pregnancy. A previous study estimated that GVK EMRI '108' ambulance services contributed to a 15 % reduction in the MMR in 2009 in (undivided) Andhra Pradesh by facilitating the proportion of institutional deliveries and probable lives saved [30]. However, the analysis was a crude estimation without accounting for the proportion of obstetric emergencies transported, and other social, economic and health system factors. Another study conducted in the state of Punjab in 2013, observed that there was sudden increase in institutional deliveries

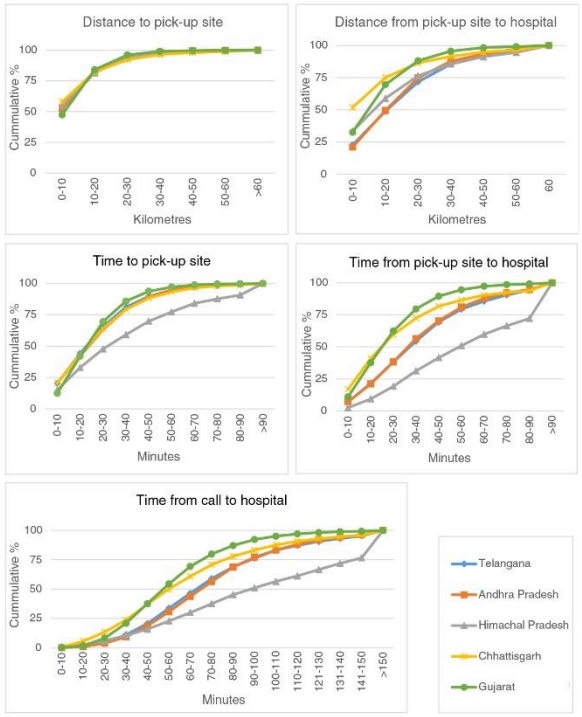


Fig. 1 Distance and time travelled by 108 ambulance for women with obstetric emergency

immediately after initiation of '108' ambulance service, but the adjusted analysis suggested that '108' did not significantly contribute to this increase in institutional delivery [31].

However most complications arise during or after delivery [32].. While most of the pregnant women were transported by '108' during normal labour pains, it is likely that some may have developed complications after reaching the hospital. In DLHS-4, 23.8 %, 19.9 % and 45.6 % pregnant women in Telangana, Andhra Pradesh and Himachal Pradesh respectively had a complication during delivery, and 15.8 %, 21.7 % and 21.0 % post-delivery respectively [27–29]. It is also possible that women with emergency preferred to use their own vehicle or other faster means of transport than waiting for '108'. A study in three districts of (undivided) Andhra Pradesh in 2009 showed that 43.5 % of patients (including pregnant women) admitted to causality departments used '108' ambulances, and 56 % of the '108' users resided within 20 kms of the hospital. Only 10 % of the non-users called '108', but an ambulance was not available for them. Among the non-users of '108', 67 % hired a private taxi/auto, 20 % used their own vehicle, 7 % used other private ambulances and the remaining used other modes of transport [33].

Among obstetric emergencies transported by '108' in this analysis, only 4.5 % in Gujarat and between 13 % and 25 % in other states were inter-facility transfers. It appears that the pregnant women who developed complication while at home either called '108' and left for higher level facility directly, or in case of inter-facility transfer they used other means of transport without waiting for a '108' ambulance. The Chiranjeevi scheme in Gujarat could also have contributed to a low proportion of inter-facility transfers in the state. The Chiranjeevi scheme provides free normal and surgical delivery care to the poor close to their home, with private hospitals providing CEmOC services. This could possibly have reduced the need of referral and transfer in case of an emergency [34].

We observed a higher proportion of pregnant users of '108' in Himachal Pradesh including for inter-facility

transfers compared to the other states. Himachal Pradesh has a hilly terrain and the time taken to travel to reach hospital was longer compared to similar distances in other states. The availability of EMT and stabilizing care during the longer time of travel may be the reason for higher usage of '108' ambulances in Himachal Pradesh. However other social factors also need to be explored.

The '108' ambulances took longer than the targeted 20 min to reach a hospital for more than 60 % to 80 % pregnant women in the study states. The women with obstetric emergencies travelled larger distances and in longer time compared to women without emergencies. This was probably due to the fact that the emergency cases had to be transported across longer distances from rural towns to district headquarters. Overall time from call to reaching the hospital was less than 2 h for 61 % pregnant women with emergency in Himachal Pradesh and between 89 % and 98 % in other states.

A main limitation of our study is that details on the type of emergency were based on the clients claim, or the doctor's report (in case of IFT) or the diagnoses by the EMT. Thus the skill for diagnoses made for emergencies was not uniform and may be inaccurate. This may affect the validity of the reporting. It cannot be estimated if this would have led to over-estimation or under-estimation of the proportion of obstetric emergencies. Details on the type of emergency were not available for clients who were not assigned an ambulance and for most of the clients who did not use an ambulance despite being assigned one. Thus the proportion of obstetric emergencies for these two groups could not be computed. The assumption used for estimating population proportion of obstetric emergencies—that atleast 15 % of all pregnancies are likely to develop complications that may require higher level of care—is debated and may not be accurate for the study areas. Some women would have used '108' service more than once and be counted more times for the same incidence. There was no mechanism to identify these in the database. We anyhow assume that these will be a very small proportion to affect the overall results. Data for treatment given en-route, and doctors' notes on inter-facility transfers were mostly not recorded in the '108' database. Thus this aspect of the ambulance service could not be studied. Lastly, data obtained from the state of Assam missed some key variables and the information could not be obtained even after repeated requests. Thus only a few variables could be analysed.

Despite limitations in the dataset, this research had several strengths. It involved a unique analysis where the proportion of all women in the population transported by '108' was computed —both for pregnancy and pregnancy with obstetric complication and emergency. We studied their social, economic and geographical distribution which helped in assessing the coverage by '108' at the population level. We also had an advantage that the key national surveys for the country (SRS, DLHS-4, ALHS) for maternal health were conducted during the study period, thus we could triangulate datasets to drive population based interpretations.

India has achieved targeted institutional delivery rates and the debate now revolves around the role of '108' in transporting normal labour cases compared to obstetric emergencies, and strategies to increase the impact on maternal and peri-natal mortality at lower cost. One study has shown that '108' spent $17 on the operational cost for the transport of one case [23]. An important question is whether '108' type ambulances, which are sophisticated vehicles, are required to transport women in normal labour. Studies in Nigeria and India suggest that improving transport to EmOCs does not necessarily require ambulances [19, 35]. Studying the morbidity patterns during transport and after admission, and outcomes of pregnancy among users and non-users of '108', will help assess the effectiveness of transport for normal labour or obstetric emergencies.

Another important question is what should be done when the number of users of '108' plateaus over time, as is evident in Telangana and Andhra Pradesh after 10 years (Source: annual records from GVK-EMRI). Does India require interventions to further increase the use of '108' ambulances for all, and to what extent? Will that be cost-effective? Or does India require to rationalize the use of '108' by offering free services for the poor and some fee for others? Telangana and Andhra Pradesh are piloting an intervention to call the potential users of '108' in the last month of pregnancy to plan the transport and place of delivery beforehand. They foresee that this relationship will increase the use of '108' services and also help in planning ahead for the pregnant women with high-risk or any complication in pregnancy. (Source: Expert from GVK-EMRI). Evaluation of this pilot may provide insight into the acceptance of '108' services, preferences, cost and, potential and necessity of increasing the usage of '108'.

There is also the possibility of integrating '108' services with other publically financed transport intervention models in India. Haryana Swasthya Vahan Sewa and '102' ambulances system utilize the existing ambulances at the government health institutions for inter-facility transfers, drop back to homes and other elective pregnancy transports [21, 36]. These can reduce the burden on '108' making them more available for emergency transports requiring stabilizing care. Another Janani Express model in Madhya Pradesh utilizes local private taxi operators to transport pregnant women on subsidised rates although without any supportive medical

treatment. These are very successful in remote places. It is suggested that these interventions can be combined with centrally managed '108' ambulance services to increase the reach to the wider population [21].

Conclusions

The '108' ambulances were used by less than one-fifth of women in 6 Indian states estimated to be pregnant over the period 2013–14. Use was more prevalent among the poor, and lower social and economic sections of the population. Although '108' is assumed to play a pivotal role in providing pre-hospital stabilizing care in obstetric emergencies, only a small proportion of journeys made by pregnant women were for complications or emergency in pregnancy. Although there is a large proportion of pregnant women who do not use '108', it is probable that they prefer other modes of transport. Further community- based studies are required to study the knowledge, and preferences of pregnant women in different sections of society and to assess the potential of increasing or rationalising the use of '108' services.

Abbreviations

AHS: Annual Health Survey; DLHS: District Level Household Survey; EmOC: Emergency Obstetric care; EMT: Emergency Medicine Technician; GVK-EMRI: GVK - Emergency Medicine Research Institute; IFT: Inter-facility transfers; SRS: Sample Registration System

Acknowledgements

We acknowledge GVK-EMRI for sharing the data and allowing scientific study without any interference.

Funding

This work was supported by a Wellcome Trust Capacity Strengthening Strategic Award to the Public Health Foundation of India and a consortium of UK universities. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Availability of data and materials

The data were obtained and analysed within the premises of GVK-EMRI office under license for the current study. The data are not publically available however can be available upon reasonable request directly to GVK-EMRI.

Authors' contributions

Conceived and designed the protocol: SS, PD, OC, GVR, GVS. Contributed in analysis plan: SS, PD, OC, GVS. Analyzed and interpreted the data: SS. Contributed in preparation of manuscript: SS, PD, OC, GVR, GVS. All authors read and approved the final manuscript.

Competing interests

The authors declared that they have no competing interests.

Consent for publication

Not applicable as this was an analysis of secondary data.

Ethics approval and consent to participate

The research obtained ethics approval from ethics committees of both LSHTM and IIPH-Hyderabad. (LSHTM Ethics Ref: 9613; IIPHH Ethics Ref: IIPHH/TRC/IEC/009/2014).

Author details

[1]Indian Institute of Public Health-Hyderabad, Public Health Foundation of India, Hyderabad, Telangana, India. [2]Department of Non-communicable Disease Epidemiology, Faculty of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, UK. [3]Department of Infectious Disease Epidemiology, Faculty of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, UK. [4]GVK-EMRI, Hyderabad, Telangana, India. [5]Department of Clinical Research, Faculty of ITD, London School of Hygiene and Tropical Medicine, London, UK.

Received: 3 February 2016 Accepted: 13 October 2016
Published online: 21 October 2016

References

1. WHO. The World Health Report 2005: Make every mother and child count. Geneva: WHO; 2005.
2. Holmes W, Kennedy E. Reaching emergency obstetric care: overcoming the 'second delay'. Burnet Institute on behalf of Compass, the Women's and Children's Health Knowledge Hub: Melbourne; 2010.
3. UNFPA. The UNFPA Emergency Obstetric Care Checklist for Planners. New York: UNFPA; 2002.
4. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. Soc Sci Med. 1994;38(8):1091–110.
5. Hussein J, Kanguru L, Astin M, Munjanja S. The effectiveness of emergency obstetric referral interventions in developing country settings: a systematic review. Plos medicine. 2012;9(7):e1001264.
6. NRHM. All India executive summary: status as on 31st March 2013. New Delhi: GOI; 2013. http://www.nrhm.gov.in/images/pdf/monitoring/progress-nrhm/all_india_executive_summary_status_as_on_30-06-2013.pdf. Accessed 16 Jan 2016.
7. Registrar General of India. SRS: Maternal Mortality Ratio Bulletin 2011–2013. New Delhi: RGI, GOI; 2014. http://www.censusindia.gov.in/vital_statistics/mmr_bulletin_2011-13.pdf. Accessed 16 Jan 2016.
8. Registrar General of India. SRS Statistical report 2007. New Delhi: RGI, GOI; 2008.
9. Registrar General of India. Special bulletin on Maternal Mortality in India 2007–2009: Sample Registration System. New Delhi: RGI, GOI; 2011. http://www.censusindia.gov.in/vital_statistics/SRS_Bulletins/Final-MMR%20Bulletin-2007-09_070711.pdf. Accessed 16 Jan 2016.
10. International Institute for Population Sciences. National Family Health Survey (NFHS-3), India: 2005–06. Mumbai: IIPS; 2008.
11. UNICEF. Levels & Trends in Child Mortality: Report 2015. Estimates Developed by the UN Inter-agency Group for Child Mortality Estimation United Nations Levels. New York: UNICEF, 2015.
12. Alkema L, Chou D, Hogan D, Zhang S, Moller A, Gemmill A, et al. Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. Lancet (online). 2015;387(10017):462-474.
13. Hohlagschwandtner M, Husslein P, Klebermass K, Weninger M, Nardi A, Langer M. Perinatal mortality and morbidity. Comparison between maternal transport, neonatal transport and inpatient antenatal treatment. Archs Gynecol Obstet. 2001;265:113–8.
14. Ganatra BR, Coyaji KJ, Rao VN. Too far, too little, too late: a community-based case–control study of maternal mortality in rural west Maharashtra, India. Bull World Health Organ. 1998;76(6):591–98.
15. Iyengar K, Iyengar SD, Suhalka V, Dashora K. Pregnancy-related deaths in rural Rajasthan, India: exploring causes, context, and care-seeking through verbal autopsy. J Health Popul Nutr. 2009;27(2):293–302.
16. Singh S, Murthy GV, Thippaiah AT, Upadhyaya S, Krishna M, Shukla R, et al. Community Based Maternal Death Review: Lessons Learned from Ten Districts in Andhra Pradesh,India. Matern Child Health J. 2015;19(7):1447–54.
17. MOHFW. NRHM- Meeting people's health needs in patnership with states: The Journey so far, 2005–2010. MOHFW, GOI: New Delhi; 2011.
18. MOHFW. Directory of Innovations implemented in health sectors. In: Development of International development. MOHFW. New Delhi: GOI; 2009. p. 29–34.
19. UNICEF. Operating Perinatal Referral Transport Services in Rural India: A toolkit. New Delhi: UNICEF; 2010.
20. NHM. Janani Shishu Suraksha Karyakaram (JSSK). GOI; 2012. http://www.nhp.gov.in/janani-shishu-suraksha-karyakaram-jssk_pg. Accessd 16 Jan 2016.
21. NHSRC. Emergency Medical Services (EMS) in India: A concept paper. New Delhi: MOHFW, GOI; 2010.
22. The Institute of Health Systems. A study of Emergency Response Services in Three Districts of Andhra Pradesh. New Delhi: NHSRC, GOI, 2011.

23. Kumutha J, Rao GVR, Sridhar BN, Vidyasagar D. The GVK EMRI maternal and neonatal transport system in India: A mega plan for a mammoth problem. Seminars in Fetal & Neonatal Medicine. 2015;20(5). doi:10.1016/j.siny.2015.07.003.
24. Kumutha J, Rao GVR, Sridhar BN, Vidyasagar D. The GVK EMRI maternal and neonatal transport system in India: A mega plan for a mammoth problem. Seminars in Fetal & Neonatal Medicine. 2015;20(5).
25. NHSRC. Publicly Financed Emergency Response and Patient Transport Systems Under NRHM. New Delhi: MOHFW, GOI; 2012.
26. NHSRC. Study of Emergency Responce Services - EMRI model. New Delhi: MOHFW; 2009.
27. IIPS. Telangana: District level household and facility survey (2012–13) Mumbai: MOHFW. 2014. GOI, https://nrhm-mis.nic.in/DLHS4/Reports/Telangana.pdf. Accessed 16 Jan 2016.
28. IIPS. Andhra Pradesh: District level household and facility survey (2012–13) Mumbai: MOHFW, GOI; 2014. https://nrhm-mis.nic.in/DLHS4/Reports/Andhra%20Pradesh.pdf. Accessed16 Jan 2016.
29. IIPS. Himachal Pradesh: District level household and facility survey (2012–13) Mumbai: MOHFW, GOI; 2014. https://nrhm-mis.nic.in/DLHS4/Reports/Himachal%20Pradesh.pdf. Accessed 16 Jan 2016.
30. Jena B, Bharadwaj D, Rao GV. Strategy towards achieving a safe motherhood in India: a case study of GVK-EMRI. In: Somauajulu UV, Prakasam CP, Audinarayana N, Vaidyanathan KF, editors. Health, poverty and human development: perspectives and issues. India: Serials Publications Pvt. Ltd; 2011.
31. Prinja S, Bahuguna P, Lakshmi PVM, Mokashi T, Aggarwal AK, Kaur M, et al. Evaluation of publicly financed and privately delivered model of emergency referral services for maternal and child health care in India. Plos ONE. 2014; 9(10):e109911. doi:10.1371/journal.pone.0109911.
32. Ronsmans C, Graham WJ. Lancet Maternal Survival Series steering group. Maternal mortality: who, when, where, and why. Lancet. 2006;368(9542): 1189–200.
33. Institute of Health Systems. A study of Emergency Response Services in three districts of Andhra Pradesh. IHS: Hyderabad; 2011.
34. Mavalankar D, Singh A, Patel SR, Desai A, Singh PV. Saving mothers and newborns through an innovative partnership with private sector obstetricians: Chiranjeevi scheme of Gujarat, India. Int J Gynecol Obstet. 2009;107:271–6.
35. Shehu D, Ikeh AT, Kunaa MJ. Mobilizing transport for obstetric emergencies in northwestern Nigeria. Int J Gynecol Obstet. 1997;59(Supp. 2):S173–80.
36. Prinja S, Aggarwal AK, Kaur M. Evaluation of Haryana Emergency Ambulance Services. New Delhi: PGIMER, Chandigarh & NHSRC; 2011.

ANNEX VIII: PAPER 3: INTER-FACILITY TRANSFER OF PREGNANT WOMEN USING PUBLICLY FUNDED EMERGENCY CALL CENTRE-BASED AMBULANCE SERVICES: A CROSS-SECTIONAL ANALYSIS OF SERVICE LOGS FROM FIVE STATES IN INDIA

London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
www.lshtm.ac.uk

Registry
T: +44(0)20 7299 4646
F: +44(0)20 7299 4656
E: registry@lshtm.ac.uk

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	SAMIKSHA SINGH
Principal Supervisor	PAT DOYLE
Thesis Title	REFERRAL SYSTEMS AND TRANSPORT FOR EMERGENCY OBSTETRIC CARE IN INDIA

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	BMJ open. 9;7(6):e015077		
When was the work published?	2016		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	No		
Have you retained the copyright for the work?*	No	Was the work subject to academic peer review?	Yes

**If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.*

SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	Choose an item.

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I planned and conducted the research, and wrote the manuscript first draft.

Student Signature: [redacted] **Date:** 19 September 2017

Supervisor Signature: [redacted] **Date:** 19 September 2017

Open Access Research

BMJ Open

Interfacility transfer of pregnant women using publicly funded emergency call centre-based ambulance services: a cross-sectional analysis of service logs from five states in India

Samiksha Singh,[1] Pat Doyle,[2] Oona MR Campbell,[3] Laura Oakley,[2] GV Ramana Rao,[4] GVS Murthy[1,5]

To cite: Singh S, Doyle P, Campbell OMR, *et al*. Interfacility transfer of pregnant women using publicly funded emergency call centre-based ambulance services: a cross-sectional analysis of service logs from five states in India. *BMJ Open* 2017;**7**:e015077. doi:10.1136/bmjopen-2016-015077

► Prepublication history and additional material are available. To view these files please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2016-015077).

Received 7 November 2016
Revised 2 May 2017
Accepted 9 May 2017

For numbered affiliations see end of article.

Correspondence to
Dr Samiksha Singh;
samiksha.singh@iiphh.org

ABSTRACT

Objective To estimate the proportion of interfacility transfers (IFTs) transported by '108' ambulances and to compare the characteristics of the IFTs and non-IFTs to understand the pattern of use of '108' services for pregnant women in India.

Design A cross-sectional analysis of '108' ambulance records from five states for the period April 2013 to March 2014. Data were obtained from the call centre database for the pregnant women, who called '108'.

Main outcomes Proportion of all pregnancies and institutional deliveries in the population who were transported by '108', both overall and for IFT. Characteristics of the women transported; obstetric emergencies, the distances travelled and the time taken for both IFT and non-IFT.

Results The '108' ambulances transported 608 559 pregnant women, of whom 34 993 were IFTs (5.8%) in the five states. We estimated that '108' transferred 16.5% of all pregnancies and 20.8% of institutional deliveries. Only 1.2% of all institutional deliveries in the population were transported by '108' for IFTs—lowest 0.6% in Gujarat and highest 3.0% in Himachal Pradesh. Of all '108' IFTs, only 8.4% had any pregnancy complication. For all states combined, on adjusted analysis, IFTs were more likely than non-IFTs to be for older and younger women or from urban areas, and less likely to be for women from high-priority districts, from backward or scheduled castes, or women below the poverty line. Obstetric emergencies were more than twice as likely to be IFTs as pregnant women without obstetric emergencies (OR=2.18, 95% CI 2.09 to 2.27). There was considerable variation across states.

Conclusion Only 6% institutional deliveries made use of the '108' ambulance for IFTs in India. The vast majority did not have any complication or emergency. The '108' service may need to consider strategies to prioritise the transfer of women with obstetric emergency and those requiring IFT, over uncomplicated non-IFT.

Strengths and limitations of this study

- ► This study is the first to assess the role of the '108' ambulance service— the largest provider of the free emergency medical services in India—for interfacility transfers (IFTs) of pregnant women.
- ► We assessed the characteristics of pregnant women who were transported by '108' as IFTs and compared them with those who were transported by '108' as non-IFTs, for five states.
- ► We did extensive cleaning and management of data to drive appropriate information.
- ► '108' service did not record information on postpartum obstetric emergency separately thus these could not be estimated.
- ► Diagnosis of obstetric emergency may be inaccurate and subject to interobserver bias.
- ► The '108' database mostly did not record data for treatment given en route, and doctors' notes on IFTs, thus we could not study these data.
- ► Some population estimates are based on assumptions and may not be accurate.
- ► We had large proportions of missing information on social and economic status from two states. We did a complete analysis and sensitivity analysis to deal with missingness.

BACKGROUND

India had an estimated 83% women delivering in health facilities in 2013.[1] Despite this high proportion of institutional births, India had an estimated maternal mortality ratio (MMR) of 167/100 000 live births and an early neonatal mortality rate of 28/1000 live births in 2013.[2] The country accounts for 17% (50 000) of global maternal deaths per year[3] and 26% (696 000) of global neonatal deaths.[4] Many maternal deaths occur during transit to health facilities.[5–7]

Interfacility transfers (IFTs) for pregnant women are crucial, especially in resource-poor countries where most peripheral health facilities provide only uncomplicated birthing or basic emergency obstetric care.[8 9] About 14%–36% of women delivering in facilities

are referred from lower-level to higher-level facilities.[10–13] As IFT is more likely to be due to referral for high-risk pregnancies or complications during pregnancy, childbirth or post-partum, it can play a pivotal role in reduction of maternal morbidity and mortality.[14 15]

Ensuring an uneventful IFT is part of good healthcare provision at the referring facility, and will reduce delays in access to appropriate healthcare (delay type 2) and delays in getting appropriate care after reaching a health facility (delay type 3).[16 17] A good process will include prompt arrangement of transport, en route stabilisation, communication with the referral facility to prepare them for the patient and appropriate hand over on arrival. IFT is thus a complex coordinated effort made by the referring healthcare provider, the en route attendant, the receiver at the referral health facility and the referral transport system.[16] Several successful interventions have been reported in resource-poor countries to improve referral transportation, but only a few mention IFT.[18 19] Referral transport for IFT may be (a) an ambulance based at the referring facility, (b) an ambulance called from a referral facility, (c) an independent ambulance service, (d) other subsidised public or commercial transport or (e) personal or commercial (non-subsidised) transport.[16 20]

India, currently, does not have any structured interfacility referral and transportation protocols for pregnant women (desk review and personal communication with Maternal health specialist, Government of India). In India, most peripheral health facilities do not have functional ambulances of their own and if they do, they are not available round the clock.[14 21 22] Thus, IFT for pregnant women depends on other referral transport services, the majority using the free, public funded '108'/'102' call centre-based ambulance services[19 23 24] and paid subsidised, commercial or personal transport. There are other services across states that, unlike '108', are basic patient transportation services with no en route stabilisation care. These may also provide transport between facilities.[21 25 26] For example, Janani Express yojana (public private non-ambulance transport service), operating through call centres within districts, transfers exclusively pregnant women and newborns in Madhya Pradesh and Odisha.[21 25] In larger cities, some other ambulance services (free or paid) are also available.

There have been very few research studies on transportation for IFTs of pregnant or postpartum women in India, despite the large investments made in public referral transport. This study was conducted to investigate IFTs of pregnant women in India using '108' ambulance services. The objectives of the research were to (i) estimate proportion of women transferred by '108' among all institutional deliveries in the general population, (ii) estimate the proportion of IFTs transferred by '108' among all institutional deliveries in the population, (iii) estimate the proportion of IFTs among all transfers of pregnant women by '108' and (iv) compare the characteristics of the IFTs and non-IFTs.

METHODS

Context

The '108' ambulance service operates under a public-private partnership. It operates 7361 ambulances, and transfers any medical emergency across 21 states and union territories (smaller less populated administrative units in India).[26] GVK-Emergency Management and Research Institute (GVK-EMRI) is the largest service provider for '108' and operates in 15 states and 2 union territories. In 2014–2015, GVK-EMRI '108' ambulances transferred about 3.6 million pregnant women to health facilities, which were about two-fifths of all the transfers by GVK-EMRI '108'.[23] There is approximately one ambulance for every 1 00 000 population, and the ambulance should be well equipped and accompanied by an Emergency Medicine Technician (EMT). The EMT is trained to provide emergency care and basic life support in obstetrics. In cases of imminent childbirth, the EMT is expected to assist the delivery en route and transfer the mother and child to the nearest health facility.[27] For IFTs, the EMT consults the '108' call centre-based medical officer and the referring healthcare provider to discuss indication of referral, stability of case to withstand travel, stabilising care required and place of referral (source: expert from GVK-EMRI). '108' service preferably transfers mother to public facilities; however, in absence of appropriate public facility nearby, they transfer the mother to empanelled private facility.[27]

Working definitions

IFT, for this study, was defined as any transfer of a pregnant woman from one health facility to another health facility on the advice of a healthcare provider, using a '108' ambulance. All other transfers of pregnant women to health facilities using '108' ambulances were defined as 'non-IFT'. These mostly included transfers from home to facility.

An obstetric emergency was defined as any life-threatening medical complication in women in pregnancy, labour or childbirth, or after (within 42 days of termination of pregnancy). For IFT women, diagnosis of obstetric emergency was made by the referring doctor and noted by EMT after discussion with call centre-based doctor. For non-IFT, diagnosis was made by EMT. We observed that even high-risk such as previous caesarean section and precious pregnancy were considered obstetric emergency by '108' services thus we included them.[28]

Study design

This cross-sectional study analysed '108' ambulance records from five states. Ethical approval for the study was obtained from Indian Institute of Public Health-Hyderabad and London School of Hygiene and Tropical Medicine.

Study population

Pregnant women who called '108' or for whom a relative or friend or healthcare provider called on their behalf,

between 1 April 2013 and 31 March 2014 in the five states in India where GVK-EMRI operated '108' service had been fully functional for more than 3 years were included in this analysis (Andhra Pradesh, Chhattisgarh, Gujarat, Himachal Pradesh and Telangana). The period 1 April to 31 March was aligned with reporting period of state governments. States were chosen in a manner that they had representation of North, South, East and West of India.

Obtaining data and data management

Formal permission to use the data was obtained from GVK-EMRI. Anonymised information on '108' calls from 1 April 2013 to 31 March 2014 was obtained from the GVK-EMRI emergency response centre database. Details on data management are described in another paper from the same dataset.[28] Data were extracted onto Excel sheets, and converted to STATA V.10.0 files. Data were inspected to assess consistency, range and missing data. Any gross issue relating to the quality of records was noted, and records with improbable entries were excluded from analysis. Variables were recoded wherever needed. Variables of interest were: IFT; age of pregnant woman; social caste (general, other backward, schedule tribe and scheduled caste); economic class (below or above poverty line); area (rural or urban); type of emergency; time of call; day of call; time taken by ambulance to reach the client; time taken to reach the health facility and distance travelled. Castes are classified based on historically backward and deprived social castes. The information was provided by the caller and EMT, and recorded in the call centre database. Districts within states were stratified into high priority districts and non-high priority districts. High priority districts are those identified by the Government of India as being in the lowest quartile of districts (or tribal districts) in each state with respect to maternal and child health indicators (including institutional delivery rate, maternal mortality and neonatal mortality rates among a total of 16 indicators).[29]

Analysis

We used information from the Census 2011, District-Level Household Survey (DLHS) 2012–2013,[30–32] and Annual Health Survey (AHS) 2012–2013,[33] to estimate the number of pregnancies and institutional deliveries in the population for the study states, as mentioned below. The numbers of pregnant women transported by '108' as recorded in the call centre database were compared with these population estimates for each state.

For each state, the number of pregnancies in the study period was estimated as sum of estimated pregnancies in rural and urban population (population (rural)×crude birth rate (rural)×1.1×1000)+(population (urban)×crude birth rate (urban)×1.1×1000). The population data were obtained from the 2011 census and the crude birth rates from the Sample Registration System 2013. The multiplier 1.1 is used to account for an estimated 10% of the pregnancies which may have ended in abortions or intrauterine deaths.[34]

The number of institutional deliveries in the study period was estimated as (estimated number of pregnancies (rural)×institutional delivery rate (rural) ×100) + (estimated number of pregnancies (urban)×institutional delivery rate (urban)×100). Institutional delivery rates include live births and stillbirths. The institutional delivery rate were obtained from DLHS-4 and AHS-2 surveys.

Information was analysed for all states combined and separately by state, comparing IFT and non-IFT. The characteristics of the women transported, distances travelled and the time taken by '108' ambulances were described for both IFT and non-IFT journeys. The association between sociodemographic and clinical variables and the outcome (IFT vs no-IFT) was investigated using bivariate and multivariate logistic regression.

Social caste and economic class were missing in 55% and 95% of observations in the state of Chhattisgarh, and 14% and 22% in Himachal Pradesh. Given the nature of the variables, we decided that it was likely that the data were missing not at random, and therefore multiple imputation was considered inappropriate. In order to investigate possible selection bias resulting from missing data, we performed a complete case analysis for each state and all states combined, supplemented by a series of sensitivity analyses. Our first sensitivity analysis involved running a model with and without states of Chhattisgarh and Himachal Pradesh. Presence or absence of these states did not substantially change the pattern of results. The second sensitivity analysis was performed by running a model with and without social caste and economic class for all states combined (total) and for individual states. The presence or absence of these variables did not substantially change the magnitude of the pattern of results (ORs and R^2 for each model) for the total and for states (except Chhattisgarh). For our main analysis (all states combined), we thus included social caste and economic class variables and excluded any data from Chhattisgarh. Models for individual states (except Chhattisgarh) also include social caste and economic class.

RESULTS

Study populations

The study states had population sizes ranging from 6 to 60 million and had different social compositions (table 1). The percentage of rural population ranged from 61% in Telangana to 90% in Himachal Pradesh, while scheduled castes and tribes, together, ranged from 22% in Andhra Pradesh and Gujarat to 43% in Chhattisgarh. The crude birth rate was lowest in Himachal Pradesh (1.6%) and highest in Chhattisgarh (2.5%). The states also varied in the institutional delivery rates from 39.5% in Chhattisgarh to 94.1% in Telangana, and in their MMRs from 244 in Chhattisgarh to 92 per 1 00 000 live births in Telangana and Andhra Pradesh. On an average, '108' ambulance is

Table 1 Demographic characteristics of the study states

	Andhra Pradesh	Chhattisgarh	Gujarat	Himachal Pradesh	Telangana
Total population*	49 386 799	25 540 196	60 383 628	6 856 509	35 193 978
Rural/tribal	70.4%	76.8%	57.4%	90.0%	61.3%
Urban	29.6%	23.2%	42.6%	10.0%	38.7%
Scheduled caste*	17.1%	12.8%	6.8%	25.2%	15.4%
Scheduled tribe*	5.3%	30.6%	14.8%	5.7%	9.3%
Crude birth rate per 1000 population†	17.5	24.5	21.1	16.2	17.5
Institutional delivery rate per 100 childbirth‡	88.5%	39.5%	78.1%	77.8%	94.1%
MMR per 100 000 livebirths (2011–2013)†	92	244	112	Not available	92
Neonatal Mortality Rate per 1000 livebirths (2012–2013)†	25	31	26	25	25
No. of ambulances under '108'§	468	240	506	171	334
Geographic region/terrain	Tribal pockets	Large tribal; hilly pockets	Tribal pockets	Majority hilly	Tribal pockets

*Census 2011.
†Sample Registration System 2013—separate data for Telangana and Andhra Pradesh not available.
‡DLHS (2012–2013)/AHS (2011–2012).
§GVK-EMRI annual report for period April 2013–March 2014.
¶In Chhattisgarh, '102' ambulance service took over from October 2013 to March 2014.
AHS, Annual Health Survey; DLHS, District-Level Household Survey; GVK-EMRI, GVK-Emergency Management and Research Institute.

sanctioned for approximately 100 000 population in all states except Himachal Pradesh where one ambulance caters to about 40 000 population. Himachal Pradesh is mostly hilly and has sparse population distribution and '108' ambulances are stationed based on geographic regions.

Description of 108 calls relating to pregnancy

Across the five states, '108' call centres received 646 656 calls for pregnancy-related transfers, 6.2% of which were for IFT. Among IFT calls, an ambulance was not assigned to 1.2%, and an ambulance was assigned but not used by 6.0% of callers. Among non-IFT callers, these proportions were 1.4% and 3.9%, respectively. A total of 608 559 pregnant women were transported using '108', and of these journeys 5.8% were for IFT.

Estimated proportions of pregnancies, institutional deliveries and IFTs transported by '108'

Table 2 presents estimates of the number of pregnant women, obstetric emergencies, institutional deliveries and IFTs in the general populations, and the proportion of these transported using '108' ambulances in the five states, and overall. The 608 559 pregnant women transferred comprised 16.5% of all estimated pregnancies, and 20.8% of all estimated institutional deliveries for the study states combined.

Of the estimated institutional deliveries, '108' transported only 1.2% (34 993) women between facilities across states. This proportion was highest in Himachal Pradesh (3.0%) followed by Andhra Pradesh (1.7%), Telangana (1.4%), Chhattisgarh (0.7%) and lowest in Gujarat (0.6%). Only 1.0% (28 448) of all institutional deliveries were transported by '108' for obstetric emergencies—highest 2.4% in Himachal Pradesh and lowest 0.6% in Andhra Pradesh and Telangana (table 2).

Characteristics of pregnant women transferred by '108' ambulances

The pregnant women who were transferred by '108' belonged mostly to lower social and economic sections—rural or tribal areas (84.6%) or scheduled castes or tribes (64.9%) and below-the-poverty-line status (76.6%). Two hundred and forty-two women (40 per 100 000) died before the ambulance reached the pick-up site. The proportion of pregnant women who died before arrival of '108' ambulance was higher in Chhattisgarh (150 per 100 000) compared with other states.

Of the pregnant women transferred by '108' ambulances, 34 993 (5.8%) had an IFT (table 3). The proportion of IFTs among women transported by '108' was highest in Himachal Pradesh (11.3%) followed by Andhra Pradesh (9.9%), Telangana (8.7%), Chhattisgarh (3.2%) and Gujarat (2.4%).

Overall, IFTs were made up of a higher proportion of younger women, women from backward caste, belonging to below-the-poverty-line and from urban areas compared with non-IFTs. A similar pattern was observed across all the states except in Himachal Pradesh where IFTs had lower proportion of women from below-the-poverty-line strata compared with non-IFTs (table 3). Delivery en route or in

Table 3 Demographic characteristics of users of '108' ambulance service for IFT and non-IFT in states (April 2013 to March 2014)

	Total		Andhra Pradesh		Chhattisgarh		Gujarat		Himachal Pradesh		Telangana	
	IFT (n=34 993) (5.8%)	Non-IFT (n=573 566) (94.2%)	IFT (n=14 574) (9.9%)	Non-IFT (n=132 800) (90.1%)	IFT (n=1929) (3.2%)	Non-IFT (n=58 881) (96.8%)	IFT (n=6562) (2.4%)	Non-IFT (n=263 509) (97.6%)]	IFT (n=2809) (11.3%)	Non-IFT (n=22 114) (88.7%)	IFT (n=9119) (8.7%)	Non-IFT (n=96 262) (91.3%)
Age group (years)												
≤19	4.1	3.4	5.0	4.8	7.1	5.8	2.3	2.0	4.4	5.7	3.5	3.6
20–24	58.7	56.5	64.9	65.7	54.9	56.4	52.0	51.9	48.3	51.6	58.6	58.9
25–30	28.1	30.6	24.0	24.9	25.0	27.9	30.1	33.2	34.5	32.0	31.4	32.2
30–34	6.5	7.2	4.2	3.3	8.9	7.2	11.3	9.9	9.4	8.0	4.8	4.1
≥35	2.6	2.3	1.9	1.2	4.1	2.7	4.3	3.0	3.4	2.7	1.7	1.2
Total non-missing	(32 538) 100	(551 568) 100	(13 105) 100	(120 155) 100	(1914) 100	(58 591) 100	(6562) 100	(263 508) 100	(2779) 100	(21 694) 100	(8178) 100	(87 620) 100
Missing	(2455) 7.0	(21 988) 3.8	(1469) 10.1	(12 645) 9.5	(15) 0.8	(290) 0.5	(0) 0	(1) 0	(30) 1.1	(420) 1.9	(941) 10.3	(8642) 9.0
Social caste												
General caste	12.2	11.3	10.8	10.9	3.7	3.5	14.8	12.8	37.3	38.2	7.1	5.0
Other backward	40.0	38.5	41.7	44.1	48.5	43.8	38.3	35.0	17.4	11.5	43.4	43.5
Scheduled caste	29.1	22.1	34.7	34.1	14.3	14.7	11.2	11.1	37.2	42.8	32.2	34.2
Scheduled tribe	18.7	28.2	12.8	10.9	33.6	38.1	35.8	41.2	8.1	7.6	17.3	17.3
Total non-missing	(32 800) 100	(535 328) 100	(14 400) 100	(131 924) 100	(652) 100	(27 427) 100	(6551) 100	(263 204) 100	(2201) 100	(17 148) 100	(8996) 100	(95 625) 100
DK/missing	(2193) 6.3	(38 238) 6.7	(174) 1.2	(876) 0.7	(1277) 66.2	(31 454) 53.4	(11) 0.2	(305) 0.1	(608) 21.6	(4966) 22.5	(123) 1.3	(637) 0.7
Economic class												
BPL	87.7	75.9	99.7	99.6	96.7	97.0	54.2	55.9	62.7	67.0	99.5	99.5
Others	12.3	24.1	0.3	0.4	3.3	3.0	45.7	44.1	37.3	33.0	0.5	0.5
Total non-missing	(32 296) 100	(511 447) 100	(14 357) 100	(131 391) 100	(61) 100	(2824) 100	(6540) 100	(262 991) 100	(2395) 100	(19 041) 100	(8943) 100	(95 200) 100
DK/missing	(2697) 7.7	(62 119) 10.8	(217) 1.5	(1409) 1.1	(1868) 96.8	(56 057) 95.2	(22) 0.3	(518) 0.2	(414) 14.7	(3073) 13.9	(176) 1.9	(1062) 1.1
Area												
Rural/tribal	68.7	85.6	67.4	79.5	92.1	92.7	62.8	89.3	75.9	95.2	67.6	77.8
Urban	31.3	14.4	32.6	20.5	7.9	7.3	37.2	10.7	24.1	4.8	32.4	22.2
Total non-missing	(34 910) 100	(570 042) 100	(14 555) 100	(132 510) 100	(1929) 100	(58 881) 100	(6562) 100	(263 509) 100	(2770) 100	(18 952) 100	(9094) 100	(96 190) 100
Missing	(78) 0.2	(3524) 0.6	(19) 0.1	(290) 0.2	(0) 0	(0) 0	(0) 0	(0) 0	(39) 1.4	(3162) 14.3	(25) 0.3	(72) 0.1
Died before ambulance reached	0.07	0.04	0.04	0.02	0.36	0.14	0.02	0.03	0	0.01	0.02	0.02
Delivery en route												
At pick-up site	0.3	1.4	0.2	0.8	1.2	2.8	0.5	1.7	0.2	1.7	0.2	0.7
In ambulance	0.6	1.0	0.4	0.7	0.8	1.5	0.6	0.9	1.7	3.5	0.4	0.7

BPL, below the poverty line; IFT,interfacility transfer.

Table 4 Characteristics of transfers for IFT and non-IFT by state (April 2013 to March 2014)

	Total		Andhra Pradesh		Chhattisgarh		Gujarat		Himachal Pradesh		Telangana	
	IFT (n=94 993)	Non-IFT (n=573 566)	IFT (n=14 574)	Non-IFT (n=132 800)	IFT (n=1929)	Non-IFT (n=58 881)	IFT (n=6562)	Non-IFT (n=263 509)	IFT (n=2809)	Non-IFT (n=22 114)	IFT (n=9119)	Non-IFT (n=96 262)
Obstetric emergency, %	8.4	4.4	5.4	3.1	18.0	3.9	10.4	5.5	21.0	7.8	5.8	3.2
Abnormal presentation	1.5	2.0	1.0	1.0	1.3	1.2	3.2	3.1	0.7	0.4	1.3	1.1
Bleeding in pregnancy	3.5	0.9	2.0	0.6	1.6	0.4	4.5	1.0	14.1	5.6	2.1	0.6
Eclampsia/convulsion	0.7	0.1	0.6	0.2	0.7	0.1	0.6	0.1	1.1	0.1	0.8	0.2
Fetal loss	0.2	0.1	0.1	0.1	0.6	0.4	0.1	0.02	0.4	0.1	0.1	0.1
Medical condition	1.8	0.7	0.9	0.6	13.6	1.7	1.0	0.4	3.8	1.1	0.8	0.8
Previous caesarean	0.4	0.4	0.5	0.3	0.3	0.2	0.5	0.5	0.3	0.3	0.4	0.3
Precious pregnancy	0.3	0.3	0.2	0.2	0.1	0.1	0.5	0.4	0.5	0.2	0.3	0.2
Other emergency, %	3.7	1.8	4.1	2.8	8.7	1.2	2.3	1.0	0	0	4.2	3.5
Destination facility, %												
Government	82.0	79.6	82.1	81.7	87.6	96.8	70.2	72.0	96.0	97.6	85.3	84.1
District secondary or tertiary hospital	53.2	19.8	54.2	29.4	64.3	28.5	30.1	7.3	86.9	46.7	55.7	32.0
Area/civil hospital	19.8	13.4	18.1	21.1	0.6	0.8	31.5	8.3	7.7	27.3	21.3	22.5
Community Health Centre	7.6	34.6	8.3	19.7	20.5	57.4	7.4	43.6	0.9	20.4	6.3	16.2
Primary Health Centre	1.1	9.0	1.2	11.3	1.9	9.3	0.2	7.0	0.3	3.2	1.9	13.1
Sub-Health Centre	0	0.1	0	0	0.3	0.9	0	0	0	0	0	0
Information missing	0.4	2.8	0.3	0	0	0	0.9	5.6	0	0	0.2	0.2
Government supported	3.4	7.7	0	0	0	0	16.9	15.9	0	0	0	0
Private	14.5	12.8	17.9	18.3	12.4	3.2	12.9	12.1	4.0	2.4	14.7	15.9
Total non-missing	(31 911) 100	(531 392) 100	(12 693) 12.9	(116 028) 100	(1784) 100	(54 093) 100	(6442) 100	(256 898) 100	(2777) 100	(21 449) 100	(8215) 100	(82 924) 100
Missing	(3082) 8.8	(42 174) 7.4	(1881) 12.9	(16 772) 12.6	(145) 7.5	(4788) 8.1	(120) 1.8	(6611) 2.5	(32) 1.1	(665) 3.0	(904) 9.9	(13 338) 13.9
To different district	32.1	28.5	29.8	28.8	62.5	54.3	17.7	22.0	31.6	10.1	39.7	34.3
To different mandal	86.8	55.9	89.5	75.7	83.2	68.5	74.1	33.0	96.3	93.5	89.5	74.9
Distance call to pick-up site* (km) Median (IQR)	2 (1–14)	12 (6–18)	10 (3–18)	12 (6–19)	4 (1–6)	9 (2–17)	1 (1–10)	12 (7–18)	1 (1–1)	11 (6–18)	3 (1–15)	12 (6–20)
Distance pick-up site to hospital* (km) Median (IQR)	28 (18–40)	15 (8–23)	21 (12–31)	17 (10–26)	16 (5–30)	8 (3–15)	24 (14–37)	14 (8–21)	32 (21–48)	12 (6–20)	29 (19–43)	17 (10–28)
Time call to pick-up site* (min) Median (IQR)	11 (7–28)	25 (16–37)	24 (12–37)	27 (17–40)	15 (7–33)	27 (17–39)	10 (7–19)	24 (16–34)	12 (8–27)	35 (22–56)	12 (7–29)	26 (16–39)
Time pick-up site to hosp* (min) Median (IQR)	49 (32–70)	26 (16–40)	37 (23–55)	32 (20–46)	40 (26–64)	21 (13–32)	40 (26–60)	23 (14–34)	83 (57–116)	43 (28–65)	48 (33–70)	31 (20–48)
Time call to hospital* (min) Median (IQR)	77 (56–102)	63 (46–84)	75 (55–97)	72 (54–93)	70 (50–97)	56 (39–77)	64 (47–86)	56 (42–74)	105 (72–143)	80 (54–121)	77 (57–103)	70 (52–93)

*N varies, excludes deliveries by EMT that were not transported or missing value.
EMT, Emergency Medicine Technician; IFT, interfacility transfer.

for four states but longer (24 min) in Andhra Pradesh. The median time taken for travel from the referring to the destination facility was <40 min in Andhra Pradesh, Chhattisgarh and Gujarat but longer for Telangana (48 min) and Himachal Pradesh (83 min). For non-IFT, these times were about 30 min each, except for Himachal Pradesh where travel times were longer (table 4).

Determinants of IFT

Overall, women with obstetric emergencies transported by 108 were roughly twice as likely to have an IFT as women with no obstetric emergency (crude OR 2.25, 95% CI 2.16 to 2.34) (table 5). In the adjusted analysis (excluding Chhattisgarh), obstetric emergencies had 1.95 (95% CI 1.83 to 2.06) times higher odds of having IFT compared with non-emergencies (table 5). Women from urban areas were twice as likely to have IFTs as women in rural areas (adjusted OR (AOR) 2.34, 95% CI 2.26 to 2.40). There was no evidence of an independent effect of high-priority districts on IFT. Overall, there was evidence of a 'J'-shaped trend with maternal age. IFTs were marginally more likely in women <25, with a trend of increasing odds in women aged 30 yeas or more, compared with women aged 25–30 years (AOR 1.01, 1.04, 1, 1.21, 1.43, respectively for age groups <19, 20–24, 25–30, 30–34 and ≥35 years). Although the effects were small, women from backward castes (AOR 0.95, 95% C.I. 0.92 to 0.99), scheduled castes (AOR 0.94, 95% C.I. 0.90 to 0.98) and scheduled tribes (AOR 0.98, 95% C.I. 0.95 to 1.00) were less likely to have IFT than women from general castes, after adjustment. Women from below the poverty line (AOR 0.92, 0.88–0.96) were less likely to have IFTs compared with women above the poverty line.

The determinants of IFT had different pattern of effect across states as shown in table 5. In respect to individual state models, the association between obstetric emergencies and IFT was strongest for Chhattisgarh (AOR 5.32, 95% CI 4.70 to 6.02) followed by Himachal Pradesh (AOR 3.03, 95% CI 2.65 to 3.47).

DISCUSSION

This is the first study assessing IFTs for pregnant women using the '108' ambulance service—the largest provider of the emergency medical services in India. We discuss findings with respect to patterns of use and the existing health system.

We estimated that '108' transferred around one-fifth of all pregnancies and institutional deliveries in the five states. However, '108' service transported only 1% of all institutional deliveries in the population for IFTs. Only 1% of all institutional deliveries were transported by '108' for obstetric emergencies. The findings suggest that the '108' service is not a preferred choice for transport from lower-level facility to a higher-level facility, or for obstetric emergencies. Details about characteristics of obstetric emergencies transported by '108' ambulance services and discussion about coverage are published in another paper.[28]

The proportion of IFTs among all institutional deliveries will depend on the pattern of use of level of healthcare, referral practices and the availability of transport for between facility transfers. Roughly one-half of the non-IFTs went to peripheral birthing centres or basic Emergency Obstetric Care (EmOC) centres in our study. A systematic review from India (including most studies from public health facilities) found that between 14% and 36% of all pregnancies were referred from nurse-run delivery or basic EmOC centres, and a further 2%–7% were referred from doctor-run basic EmOC centres for complications or emergencies.[13] Assuming the pattern of use of health facilities in our study and evidence from the review, we estimate that between 40 000 and 80 000 institutional deliveries who used '108' for non-IFTs may require further referral to higher facility. In addition, among the estimated 80% (2 300 000) institutional deliveries who went to their first facility by other means of transport, some women may be referred further. Thus, the absolute numbers of pregnant women referred and requiring transport for IFT are likely to be large while '108' transports only about 35 000 pregnant women for IFT.

In our analysis, of all the transfers by '108' only 5.8% were IFTs—lowest 2.4% in Gujarat and highest 11.3% in Himachal Pradesh. The proportion of IFT was higher in states of Karnataka and Tamil Nadu (12.8% and 35.7%) among '108' users in 2013–2014.[24] It appears that there is potential for increasing use of '108' for IFTs in the study states.

A study conducted in Andhra Pradesh in 2009 found that none of the pregnant women who used '108' was referred from a facility.[35] Some women did not prefer to wait for '108' if they perceived any emergency.[35] A maternal death review in Uttar Pradesh in 2010 found that only 5 of the 32 mothers who were transferred between facilities used an ambulance.[6] However, for other public transportation schemes, it was found that a high proportion (two-thirds) of all the interfacility referrals in a study from Madhya Pradesh used Janani Express service (non-ambulance) while others used personal transport, taxis, autorikshaws or public transport.[10]

Although IFTs in our study were twice as likely to transport pregnant women who had any obstetric emergency compared with non-IFTs, there was a very large proportion of IFTs with no obstetric emergency or complication (92%). One of the '108' doctors, during discussion to understand IFT processes, mentioned that on many occasions they were not convinced of the need for IFT. However on insistence of the referring staff, the '108' doctor approved transport for IFT (personal communication). Often the referral was done because there was no doctor on duty or other resources were not available, as was also found in Madhya Pradesh.[10] These non-emergency IFTs will add unnecessary load at higher facilities and also make the ambulances unavailable for other emergencies.

Table 5 Determinants of IFT across states (logistic regression analysis showing OR (95% CI)

	Total*	Andhra Pradesh	Chhattisgarh	Gujarat	Himachal Pradesh	Telangana
Bivariate logistic regression: OR (95% CI)						
Obstetric emergency	2.25 (2.16 to 2.34)	1.81 (1.67 to 1.95)	5.39 (4.76 to 6.09)	2.01 (1.85 to 2.17)	3.15 (2.84 to 3.49)	1.90 (1.73 to 2.09)
Urban area	2.29 (2.23 to 2.34)	1.87 (1.80 to 1.94)	1.09 (0.92 to 1.29)	4.93 (4.69 to 5.20)	6.34 (5.68 to 7.07)	1.68 (1.60 to 1.76)
High priority district	0.96 (0.94 to 0.98)	1.10 (1.06 to 1.14)	1.28 (1.13 to 1.44)	0.69 (0.65 to 0.73)	0.92 (0.83 to 1.01)	0.95 (0.90 to 1.00)
Age group (years)						
≤19	1.06 (1.00 to 1.13)	1.08 (0.98 to 1.18)	1.37 (1.13 to 1.66)	1.28 (1.08 to 1.51)	0.70 (0.57 to 0.86)	1.01 (0.88 to 1.14)
20–24	1.03 (1.00 to 1.05)	1.02 (0.98 to 1.07)	1.09 (0.97 to 1.21)	1.10 (1.04 to 1.16)	0.87 (0.79 to 0.95)	1.02 (0.97 to 1.07)
25–30	1	1	1	1	1	1
30–34	1.24 (1.18 to 1.30)	1.29 (1.17 to 1.42)	1.38 (1.16 to 1.65)	1.25 (1.15 to 1.36)	1.08 (0.93 to 1.25)	1.21 (1.08 to 1.35)
>35	1.52 (1.41 to 1.64)	1.62 (1.41 to 1.86)	1.68 (1.31 to 2.15)	1.58 (1.39 to 1.80)	1.16 (0.93 to 1.46)	1.47 (1.23 to 1.76)
Social caste						
General caste	1	1	1	1	1	1
Backward caste	0.92 (0.89 to 0.96)	0.95 (0.90 to 1.01)	1.04 (0.68 to 1.58)	0.94 (0.87 to 1.02)	1.55 (1.36 to 1.77)	0.71 (0.65 to 0.77)
Scheduled caste	0.91 (0.87 to 0.94)	1.02 (0.97 to 1.09)	0.91 (0.58 to 1.44)	0.87 (0.79 to 0.96)	0.89 (0.80 to 0.99)	0.67 (0.61 to 0.73)
Scheduled tribe	0.90 (0.87 to 0.94)	1.18 (1.11 to 1.28)	0.83 (0.54 to 1.27)	0.75 (0.69 to 0.81)	1.10 (0.93 to 1.31)	0.71 (0.65 to 0.78)
Below poverty line	0.92 (0.88 to 0.96)	1.45 (1.04 to 2.01)	0.92 (0.22 to 3.80)	0.93 (0.89 to 0.98)	0.83 (0.76 to 0.90)	1.03 (0.75 to 1.41)
Multivariate logistic regression model: AOR (95% CI)†						
Obstetric emergency†	1.96 (1.83 to 2.06)	1.80 (1.65 to 1.95)	5.32 (4.70 to 6.02)	1.89 (1.74 to 2.05)	3.03 (2.65 to 3.47)	1.79 (1.61 to 1.98)
Urban area	2.35 (2.26 to 2.41)	1.86 (1.79 to 1.94)	1.09 (0.92 to 1.29)	4.75 (4.50 to 5.01)	5.76 (5.03 to 6.59)	1.64 (1.56 to 1.73)
High priority district	0.98 (0.95 to 1.00)	1.09 (1.05 to 1.13)	1.25 (1.11 to 1.41)	0.90 (0.85 to 0.96)	1.17 (1.03 to 1.33)	1.00 (0.95 to 1.06)
Age group (years)						
≤19	1.01 (0.94 to 1.06)	1.01 (0.92 to 1.11)	1.36 (1.12 to 1.65)	1.25 (1.06 to 1.49)	0.82 (0.65 to 1.05)	0.91 (0.80 to 1.05)
20–24	1.04 (0.98 to 1.06)	1.03 (0.99 to 1.08)	1.11 (1.00 to 1.24)	1.12 (1.06 to 1.18)	0.92 (0.82 to 1.03)	1.02 (0.97 to 1.07)
25–30	1	1	1	1	1	1
30–34	1.21 (1.14 to 1.27)	1.26 (1.14 to 1.39)	1.33 (1.11 to 1.59)	1.21 (1.11 to 1.32)	0.94 (0.77 to 1.14)	1.19 (1.07 to 1.34)
>35	1.43 (1.35 to 1.56)	1.56 (1.36 to 1.80)	1.52 (1.19 to 1.95)	1.44 (1.27 to 1.64)	0.96 (0.72 to 1.30)	1.43 (1.19 to 1.71)
Social caste						
General caste	1	1	NA‡	1	1	1
Backward caste	0.95 (0.92 to 0.99)	0.93 (0.87 to 0.99)	NA‡	1.02 (0.94 to 1.10)	1.80 (1.55 to 2.10)	0.79 (0.71 to 0.87)
Scheduled caste	0.94 (0.90 to 0.98)	1.02 (0.95 to 1.08)	NA‡	0.99 (0.90 to 1.09)	1.01 (0.90 to 1.14)	0.74 (0.61 to 0.73)
Scheduled tribe	0.98 (0.96 to 1.00)	1.22 (1.13 to 1.31)	NA‡	0.94 (0.87 to 1.01)	1.31 (1.08 to 1.61)	0.82 (0.67 to 0.82)
Below poverty line	0.92 (0.88 to 0.96)	1.40 (1.00 to 1.96)	NA‡	0.95 (0.90 to 1.00)	0.85 (0.77 to 0.95)	1.34 (0.95 to 1.88)
Pseudo-R^2	0.076	0.014	0.033	0.054	0.085	0.010

*Adjusted for state and does not include the state of Chhattisgarh.
†Adjusted for obstetric emergency, urban area, high priority district and age group, as appropriate.
‡For Chhattisgarh, social caste and below poverty line were not included.
AOR, adjusted OR; IFA, interfacility transfer; NA, not available.

In our study, IFTs had a higher overall proportion of women from disadvantaged social castes, below-the-poverty-line and urban areas compared with non-IFTs. Greater proportions of urban women deliver in health facilities,[30–32] and thus have a higher probability of early detection of complications and referral to a higher facility. Studies have also shown that higher proportions of women who use publically financed transportation schemes ('108'/'102'/Janani Express yojana) belong to historically disadvantaged and backward social caste, below the poverty line, are less educated and mostly from rural geographical areas compared with non-users.[21 35–38]

The median time from call to '108' and reaching the destination facility was similar for non-IFT, and IFT, and it ranged from 1 to 1.3 hour. A study of 57 maternal death reviews from Uttar Pradesh found much longer times; the mean time taken to arrange transport and travel from home to facility was about 4 hours, and transport from one facility to another was about 10 hours.[6] Although the '108' service has a mandate to inform the destination facility before arrival to reduce delays in treatment, this is not practiced as the list of contact points is not provided to EMTs (source: Dr GVR Rao). Few women were transferred to a district different from the originating district due to sparse distribution of referral facilities. These women also travelled longer distances. Continuity of care and monitoring of IFTs can be better if transfers are in same administrative unit that is, district.

The '108' ambulances are stationed close to CHCs and should be readily available, but if the ambulance is on route for pick-up or drop-off of another client then the IFT client with complications will have to wait or arrange for another means of transportation.[21] The '108' service may consider prioritising IFTs by having dedicated fleet of ambulances for IFTs over transporting all non-IFTs by increasing the fleet of ambulances stationed closer to beneficiaries.[25] In some states, the underused ambulances at the health facilities are being used through the '102' call centre along with '108'; however, the distribution of these into IFT and non-IFT use has not been well laid out.[21] In other states, '102' has new ambulances that focus on IFT or transfers back to home for pregnant women.[26] Since 2013, state of Assam has a dedicated fleet of 450 ambulances for IFTs operating through the '102' call system. Of these, over half of all IFTs were for pregnant women in 2015–2016 (source: GVK-EMRI annual statistics). This stresses the need for dedicated ambulances to deal with emergency IFTs, equipped with advanced life and obstetric support facilities. Other services like Janani Express yojana, do not provide clinical support during transfer and are found to take longer times in transfer of pregnant women.[21 25]

The role of the '108' service in improving care at the referring and referral facility, and its overall impact on maternal morbidity and mortality reduction, could not be estimated from our analysis nor has been reported in other studies. Nonetheless, the '108' service is accepted as an important and successful intervention to improve patient transportation for obstetric, medical and other emergencies.[21 24 26 35 37] A study from five states, showed that '108' ambulances provide prehospital stabilising care to all pregnant women, and delivery and postdelivery care to those delivered at home or on the ambulance.[39] However, a study from Punjab found that about half of '108' ambulances did not meet required standards for basic life support.[37] Monitoring of the quality of en route care and referral systems is integral for better outcomes and monitoring of any transport intervention.[16 21 40]

As we included representative states from all regions of India and included universal sample, our results are generalisable to the all the pregnant women transported by '108' ambulance service in India. There are a few limitations to our analysis. Details of the type of emergency in the '108' database was based on the doctor's report or the diagnoses by the EMTs for IFTs, and only the EMTs for non-IFTs. This information is thus subject to interobserver variability and differential reporting. However, we cannot estimate if this would have led to overestimation or underestimation of the effect estimate. A very few women who used '108' for antenatal care may have used it again for delivery care, and would have been counted twice. The database did not have information if the women was referred after childbirth thus postpartum referrals could not be computed separately. Data for treatment given en route, and doctors' notes on IFTs, were mostly not recorded in the '108' database and thus could not be studied. Details of the source hospital for IFTs were not available and thus details of transfers between type of facilities could not be assessed. There is a possibility that few calls for IFT for the women residing in rural areas were wrongly recorded, as they called from the health facilities in urban areas. This would have contributed to higher proportion of urban women among IFTs. The '108' service from Chhattisgarh was taken over by the '102' service since October 2013 thus use of '108' may be underestimated for this state. We had large proportions of missing information on social and economic status from two states. We considered that the missingness was not at random and was not associated with outcome. There is evidence that in such situations a complete case analysis, as we reported, is associated with negligible bias compared with a multiple imputation approach.[41]

CONCLUSION

Of all the estimated institutional deliveries in India, only a very small proportion (6%) made use of the '108' ambulance for transfer between facilities. Among '108' users for IFTs, around 92% did not have any complication or emergency. After adjusting for confounding factors, IFTs were more likely for women with obstetric emergencies, more than 30 years of age and from urban areas. Pregnant women from socially disadvantaged castes, below poverty line and from high priority districts were less likely to have IFTs. Utilisation of the '108' service and its determinants varied across states. Primary research

is required to understand variation in utilisation and to explore the potential of the '108' ambulance service to serve a higher proportion of women requiring IFTs, in particular those having obstetric emergencies. The '108' service would benefit by having a triage system to ensure that women with an obstetric emergency requiring an IFT are prioritised.

Author affiliations
[1]Indian Institute of Public Health-Hyderabad, Public Health Foundation of India, Hyderabad, India
[2]Department of Non-Ccommunicable Disease Epidemiology, Faculty of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, UK
[3]Department of Infectious Disease Epidemiology, Faculty of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, UK
[4]Emergency Medicine Learning Center and Research, GVK-Emergency Management and Research Institute, Hyderabad, India
[5]Department of Clinical Research, Faculty of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London, UK

Acknowledgements The authors acknowledge GVK-Emergency Management and Research Institute for sharing the data and allowing scientific study without any interference.

Contributors Conceived and designed the protocol: SS, PD, OC, GVR, GVSM. Contributed in analysis plan: SS, PD, OC, LO, GVSM. Analysed and interpreted the data: SS. Contributed in preparation of manuscript: SS, PD, OC, LO, GVR, GVSM.

Funding This work was supported by a Wellcome Trust Capacity Strengthening Strategic Award to the Public Health Foundation of India and a consortium of the UK universities.

Competing interests None declared.

Patient consent The study involved analysis of data saved in a call centre database. Personal identifiers were removed before analysis and reporting.

Ethics approval The research obtained ethics approval from ethics committees of both LSHTM and IIPH-Hyderabad (LSHTM Ethics Ref: 9613; IIPHH Ethics Ref: IIPHH/TRC/IEC/009/2014).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The data were obtained and analysed within the premises of GVK-EMRI office under license for the current study. The data are not publically available; however, can be available on reasonable request directly to GVK-EMRI.

REFERENCES

1. National Rural Health Mission (NRHM). *All India executive summary: status as on 31st March 2013*. New Delhi: NRHM, Government of India, 2013.
2. Registrar General of India. *SRS: maternal Mortality Ratio Bulletin 2011-2013*. New Delhi: Government of India, 2014. http://www.censusindia.gov.in/vital_statistics/mmr_bulletin_2011-13.pdf. (accessed 30 September 2016).
3. WHO. *Trends in maternal mortality: 1990 to 2013. Estimates by WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division*. Geneva: WHO, 2014. http://apps.who.int/iris/bitstream/10665/112682/2/9789241507226_eng.pdf. (accessed 30 September 2016).
4. UNICEF. *Levels & Trends in Child Mortality: Report 2015. Estimates Developed by the UN Inter-agency Group for Child Mortality Estimation United Nations Levels*. New York: UNICEF, 2015. http://www.unicef.org/publications/files/Child_Mortality_Report_2015_Web_9_Sept_15.pdf. (accessed 30 September 2016).
5. WHO. *Theworld health report 2005: Make every mother and child count*. Geneva: WHO, 2005. http://www.who.int/whr/2005/whr2005_en.pdf?ua=1. (accessed 30 September 2016).
6. Raj SS, Manthri S, Sahoo PK. Emergency referral transport for maternal complication: lessons from the community based maternal death audits in Unnao district, Uttar Pradesh, India. *Int J Health Policy Manag* 2015;4:99–106.
7. Singh S, Murthy GV, Thippaiah A, *et al*. Community based maternal death review: lessons learned from ten districts in Andhra Pradesh, India. *Matern Child Health J* 2015;19:1447–54.
8. WHO,UNFPA, UNICEF, AMDD. *Monitoring emergency obstetric care: a handbook*. Geneva: WHO, 2009. http://apps.who.int/iris/bitstream/10665/44121/1/9789241547734_eng.pdf. (accessed 30 September 2016).
9. Murray SF, Pearson SC. Maternity referral systems in developing countries: current knowledge and future research needs. *Soc Sci Med* 2006;62:2205–15.
10. Chaturvedi S, Randive B, Diwan V, *et al*. Quality of obstetric referral services in India's JSY cash transfer programme for institutional births: a study from Madhya Pradesh province. *PLoS One* 2014;9:e96773.
11. David KV, Pricilla RA, Venkatesan S, *et al*. Outcomes of deliveries in a midwife-run labour room located at an urban health centre: results of a 5-year retrospective study. *Natl Med J India* 2012;25:323–6.
12. Iyengar K, Iyengar SD. Emergency obstetric care and referral: experience of two midwife-led health centres in rural Rajasthan, India. *Reprod Health Matters* 2009;17:9–20.
13. Singh S, Doyle P, Campbell OM, *et al*. Referrals between Public Sector Health Institutions for women with Obstetric High Risk, complications, or emergencies in India - A systematic review. *PLoS One* 2016;11:e0159793.
14. Raj SS, Manthri S, Sahoo PK. Emergency referral transport for maternal complication: lessons from the community based maternal death audits in Unnao district, Uttar Pradesh, India. *Int J Health Policy Manag* 2015;4:99–106.
15. Giovine A, Ostrowski C. *Technical report on improving transportation and referral for Maternal Health: knowledge gaps and recommendations*. Washington DC, 2010. https://www.wilsoncenter.org/sites/default/files/Transport%20Referral%20Meeting%20Technical%20Report.pdf. (accessed 30 September 2016).
16. UNICEF. *Operating Perinatal Referral Transport Services in Rural India: A toolkit*. New Delhi: UNICEF, 2010. https://www.mailman.columbia.edu/sites/default/files/pdf/unicef_2010_operating_perinatal_transport_services_in_rural_india_toolkit.pdf. (accessed 30 September 2016).
17. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Soc Sci Med* 1994;38:1091–110.
18. Hussein J, Kanguru L, Astin M, *et al*. The effectiveness of emergency obstetric referral interventions in developing country settings: a systematic review. *PLoS Med* 2012;9:e1001264.
19. Ministry of Health and Family Welfare. *Directory of Innovations Implemented in the health Sector*. New Delhi: MOHFW, Government of India, 2008. http://planningcommission.nic.in/reports/genrep/health/Directory_of_innovations_march.pdf. (accessed 30 September 2016).
20. Ministry of Health and Family Welfare. *Operational guidelines on maternal and Newborn Health*. New Delhi: MOHFW, Government of India, 2010.
21. Sundararaman T, Chakraborty G, Nair A, *et al*. *Publicly financed emergency response and patient Transport Systems under NRHM*. New Delhi: Government of India, 2012.
22. Ministry of Health and Family Welfare. *Rural Health Statistics: 2014-15*. New Delhi: Statistics Division, MOHFW, Government of India, 2016. http://wcd.nic.in/sites/default/files/RHS_1.pdf. (accessed 30 September 2016).
23. Kumutha J, Rao GV, Sridhar BN, *et al*. The GVK EMRI maternal and neonatal transport system in India: a mega plan for a mammoth problem. *Semin Fetal Neonatal Med* 2015;20:326–34.
24. Raj AX. Saving lives through rural ambulance services: experiences from Karnataka and Tamil Nadu states, India. *Transport and Communications Bulletin for Asia and the Pacific* 2014;84:52–66.
25. NHSRC. *Emergency Medical servcie (EMS) in India: a concept paper*. New Delhi: NRHM, MOHFW, Government of India, 2012.
26. National Health Mission. *ERS/PatientTransport Service: NationalAmbulance Service (NAS)*. MOHFW,Government of India, 2015. http://nrhm.gov.in/nrhm-components/health-systems-strengthening/emri-patient-transport-service.html. (accessed 30 September 2016).

27. GVK-EMRI. *National footprints- Reaching unreachable*. Hyderabad, AP: GVK-EMRI, 2015. http://www.emri.in/our-presence. (accessed 30 September 2016).
28. Singh S, Doyle P, Campbell OM, *et al*. Transport of pregnant women and obstetric emergencies in India: an analysis of the '108' ambulance service system data. *BMC Pregnancy Childbirth* 2016;16:318.
29. Ministry of Health and Family Welfare. *Guidance note for implementation of RMNCH+A interventions in high priority districts*. New Delhi: MOHFW, Government of India, 2013.
30. IIPS. *Himachal Pradesh: district level household and facility survey (2012-13)*. Mumbai: MOHFW, Government of India, 2014. https://nrhm-mis.nic.in/DLHS4/Reports/Himachal%20Pradesh.pdf. (accessed 30 September 2016).
31. IIPS. *Telangana: district level household and facility survey (2012-13)*. Mumbai: MOHFW, Government of India, 2014. https://nrhm-mis.nic.in/DLHS4/Reports/Telangana.pdf. (accessed 30 September 2016).
32. IIPS. *Andhra Pradesh: district level household and facility survey (2012-13)*. Mumbai: MOHFW, Government of India, 2014. https://nrhm-mis.nic.in/DLHS4/Reports/Andhra%20Pradesh.pdf. (accessed 30 September 2016).
33. NRHM. *Formulas for calculating health and family planning indicators*: NRHM, Government of India, 2008. Available from. http://pbnrhm.org/formulas/health_indicators.pdf. (accessed 10 February 2017).
34. Registrar General of India. *Annual Health Survey 2012-13 Factsheet: chhattisgarh*. New Delhi: Ministry of Home affairs, Government of India, 2014. http://www.censusindia.gov.in/vital_statistics/AHSBulletins/AHS_Factsheets_2012-13/FACTSHEET-Chhattisgarh.pdf. (accessed 30 September 2016).
35. The Institute of Health Systems. *A study of Emergency Response Services in three districts of Andhra Pradesh*. New Delhi: NHSRC, Government of India, 2011.
36. Prinja S, Aggarwal AK, Kaur M. *Evaluation of Haryana Emergency Ambulance Services*. New Delhi: PGIMER, Chandigarh & NHSRC, 2011.
37. Prinja S, Bahuguna P, Lakshmi PV, *et al*. Evaluation of publicly financed and privately delivered model of emergency referral services for maternal and child health care in India. *PLoS One* 2014;9:e109911.
38. Prinja S, Jeet G, Kaur M, *et al*. Impact of referral transport system on institutional deliveries in Haryana, India. *Indian J Med Res* 2014;139:883–91.
39. Strehlow MC, Newberry JA, Bills CB, *et al*. Characteristics and outcomes of women using emergency medical services for third-trimester pregnancy-related problems in India: a prospective observational study. *BMJ Open* 2016;6:e011459.
40. Murray SF, Davies S, Phiri RK, *et al*. Tools for monitoring the effectiveness of district maternity referral systems. *Health Policy Plan* 2001;16:353–61.
41. White IR, Carlin JB. Bias and efficiency of multiple imputation compared with complete-case analysis for missing covariate values. *Stat Med* 2010;29:2920–31.

ANNEX IX: QUESTIONNAIRE FOR '108' TELEPHONE SURVEY

Interview of pregnant women who called the 108 service for ambulance service

A. Data from EMRI system:

Incident id no: _____		Caller Phone number: _____	
Time & Date: of call to 108 _ _ hr _ _ min ; dd /mm / yy		Time & Date: of interview _ _ hr _ _ min ; dd /mm / yy	
Mandal:		District:	
State:		Area: 1. Rural 2. Urban 3. Tribal	
Social class: 1.OBC 2.SC 3.ST 4.Others 9.DK		Eco status: 1. White card 2. Pink card 9. Don't know	
Status of transportation : 1. Availed 2. Service Not Required 3. Service Un-availed 4. Vehicle Not assigned			
Chief complaint:	Put more space to encourage open ended detail		

Introduce yourself and purpose of call. Take verbal consent.

We are trying to find out the characteristics of pregnant women who called 108 ambulance services and if they were satisfied with the services. We want to study if they had any complications and where did they go for their treatment. Was any treatment provided at home or during the journey to the hospital? What was the outcome of the pregnancy? The study will try to find out ways to increase the outreach of 108 ambulances and improvement of services.

You are being invited to participate in this health research study. It is entirely your decision to participate in the study. If you want to discontinue at any point of time, you are free to leave this study without stating any reason. Do you provide your consent to be part of this study.

Consent taken: 1. Yes 2. No

B. Read the following questions clearly and wait for response before going to next.

Q No.	Question	Options	Code Entry
1.	What is the name of the client for which the call was made?		
2.	What is your relationship with the client? Second call back no. _____	1. Husband 2. Father / Mother 3. Brother / Sister 4. Father in-law/Mother in-law 5. Brother in law/ sister in-law 6. Other relative / friend 7. ASHA / ANM/ Staff nurse / Doctor 8. Other, specify_____	
3.	What is the age of the client or year of birth?	_____ years / _ _/_ _/ _ _	
4.	How many months did this pregnancy last? If don't know enter 99	_____ months	
5.	What was the reason for calling 108? *If 1, 2, 7, or 8 skip to 8 ; If 3-6, go to 6*	*Refer the codes below.*	
6.	At the time you called was there any complication?	1.Yes 0.No 9.DK	
	If yes, what was it?	*Refer the codes below.* *Multiple responses possible.*	

Codes for reason for calling

1. MTP
2. Normal labour
3. Post-abortion complication
4. Complication in pregnancy
5. Complication during delivery
6. Complication post delivery
7. Routine antenatal check up
8. Routine postnatal check up
9. Others, specify _____

Codes for complications:

3. Post-abortion

-Early Complication

3.1 High fever
3.2 Foul smelling discharge

-Emergency

3.3 Excessive bleeding
3.4 Fits / eclampsia

4. Pregnancy

-Early Complication

4.1 High fever
4.2 Haemoglobin 7-11gm%
4.3 Haemoglobin <7gm%
4.4 Gestational hyperthyroidism or diabetes
4.5 High blood pressure
4.6 Foul smelling discharge
4.7 Infections (Malaria, Tuberculosis, HIV)

-Emergency

4.8 Bleeding per vaginum <20 wks
4.9 Decreased or absent fetal movements
4.10 Excessive bleeding
4.11 High blood pressure / pre-eclampsia and severe headache with blurred vision or epigastric pain (severe pre-eclampsia)
4.12 Convulsion or loss of consciousness
4.13 Foetal heart rate >160/minute or <120/minute
4.14 Rupture uterus
4.15 Ectopic pregnancy

5. Delivery

-Early Complication

5.1 Multiple foetus
5.2 Malpresentation
5.3 High fever

-Emergency

5.4 Preterm labour / premature rupture of membranes
5.5 Ruptured membranes for >18 hrs
5.6 Active labour> 12hrs in primi or >8hrs in multigravida
5.7 Meconium or blood stained amniotic fluid
5.8 Retained placenta or products of conception
5.9 Excessive bleeding during labour
5.10 Foetal heart rate >160/minute or <120/minute
5.11 Decreased or absent fetal movements
5.12 High blood pressure / pre-eclampsia with proteins in the urine, and severe headache with blurred vision or epigastric pain (severe pre-eclampsia)
5.13 Convulsion or loss of consciousness (seizure, eclampsia, shock)
5.14 Reduced urinary output with hypertension (renal failure, DIC)
5.15 Ruptured uterus
5.16 Ectopic pregnancy

6. Post- Delivery

-Early Complication

6.1 High fever
6.2 Foul smelling discharge

-Emergency

6.3 Perineal tear
6.4 Excessive bleeding
6.5 High blood pressure
6.6 Convulsion or loss of consciousness (seizure, shock)
6.7 Difficulty in breathing
6.8 Reduced urinary output with hypertension (renal failure, DIC)

7.	In current pregnancy, did the client have any of the following before today? *Ask for each option.* *If yes, enter – 1* *If no, enter – 0* *If don't know, enter – 9*	7.1 haemoglobin< 7gm%	
		7.2 high BP	
		7.3 convulsions / fits	
		7.4 high sugar	
		7.5 bleeding from vaginum	
		7.6 high fever	
		7.7 foul smelling discharge from vaginum	
		7.8 others, specify _____	
8.	Has the client ever been pregnant before this pregnancy? *If yes, go to 9 ; If no, go to 10*	1.Yes 0.No 9.DK	
9.	Did the client have any of the following in previous pregnancy / cies? *Ask for each option.* *If yes, enter – 1* *If no, enter – 0* *If don't know, enter – 9*	9.1 birth by operation over abdomen	
		9.2 obstructed labour	
		9.3 high BP	
		9.4 convulsions / fits	
		9.5 High sugar	
		9.6 neonatal death	
		9.7 3 or more spontaneous consecutive abortions	
		9.8 premature births	
		9.9 multiple pregnancies	
		9.10 others, specify_____	
10.	Who suggested you to call 108?	1. pregnant lady / husband 2. Friends or relatives or neighbours 3. Health staff advised during ANC 4. Referred by ASHA / AWW for current state 5. Referred by ANM/ SN/ LHV/ Doctor for current state 6. Others, specify _____	
11.	What type of hospital was the client taken to? *If 6, skip to 15*	1. Government PHC 2. Government CHC 3. Government Area hospital / District hospital 4. Private clinic 5. Private hospital 6. Did not take anywhere 9. Don't know	
12.	How much time did the ambulance / vehicle take to reach your place? (hr: min) *Enter 99 if don't know*		
13.	How much time did the ambulance / vehicle take to reach hospital from your place? *Enter 99 if don't know*		
14.	How much distance did you travel from your place to the hospital? (kilometres) *Enter 99 if don't know*		
	Question 15 &16: only for those whose transportation status is availed or service not required		
15.	If availed, who decided to go to the above hospital? If service not required, who decided to not go to any hospital?	1. Pregnant woman / relative 2. 108 emergency technician 3. Others, specify _____ 9. Don't know	

16.	What treatment was given by the 108 emergency technician before or during transportation to the hospital?	1. No treatment given 2. BP measured 3. Examination per abdomen 4. Oral medicine 5. Injection 6. I/V drip 7. Oxygen 8. First aid 9. Don't know	
	Question 17 & 18 only for those whose transportation status is un-availed or not assigned		
17.	Why did you not utilise the service of 108?	1. Case stabilised / baby delivered 2. Case was worsening and other ambulance / vehicle was arranged earlier than said time of 108 3. 108 ambulance took more than said time thus we arranged other vehicle 4. 108 did not send ambulance 5. Others, specify_____ 9. Don't know / no answer	
18.	How did you transport the case to hospital?	1. Personal car / van 2. Personal scooter / bike 3. Hired a taxi / van 4. Hired auto rickshaw 5. Community financed vehicle 6. Public transport-Bus / train 7. Another ambulance 8. Did not transport 9. Don't know	
19.	Is the client at the hospital / home? *If, 6 or 7, when?: _ _/_ _/_ _* *end here*	1. At the same hospital 2. Referred to other hospital 3. Discharged , at home 4. Was never admitted , at home 5. Re-admitted 6. Death at hospital 7. Death at home	

Ask the caller, if s/he was comfortable with your interviewing her/him. If yes, tell her/him that you will like to ask 10 more questions. Ask her/him if he would be willing to answer them now.

If s/he says yes, then proceed. If s/he says no, thank her/him and tell her/him you would be calling again within 2 days to enquire about the well being of the client.

Refer to question 8: If yes go to 20 ; If no go to 22a and enter 1 ; If DK go to 22a and enter 99

20.	Did the client have any live births before this pregnancy? How many times?	*If NO, enter 0; if yes, enter number ; if don't know, enter 99*	
21.	Did the client have any abortion / miscarriage before this pregnancy? How many times?	*If NO, enter 0; if yes, enter number ; if don't know, enter 99*	
22.	Did the client have any child born dead or died in the womb after the pregnancy has lasted for more than 28 weeks? How many times?	*If NO, enter 0; if yes, enter number ; if don't know, enter 99*	
22a	Gravida (calculate)	Sum = (answers in 20+21+22) + 1 *If answer of any of 20 to22 is 99 , enter 99*	
22b	Para (calculate) *If gravid =1, enter para =0*	Sum = (answers in 20+22) *If answer of any of 20 and22 is 99 , enter 99*	
23.	Did the client have any of the following medical illness before this pregnancy? *Ask for each option.* *If yes, enter – 1* *If no, enter – 0* *If don't know, enter – 9*	23.1 heart disease	
		23.2 high BP	
		23.3 diabetes	
		23.4 Thyroid problem	
		23.5 tuberculosis	
		23.6 HIV	
24.	Is the height of client < 150 cm / 4ft 11 inch?	1.Yes 0.No 9.Don't know	
25	How much has the client studied?	Code for education 1. Illiterate 2. Primary school 3. Middle school 4. 12th 5. Graduate 6. Post-graduate 7. Professional 9. Don't know	
26.	How much has her husband studied?		
27.	Did the client work for living before or during this pregnancy?	1.Yes 0.No 9.DK	
28.	What is the social class of the client?	1.OBC 2.SC 3.ST 4.Others 9.DK	
29.	What is the religion of the client?	1.Hindu 2.Muslim 3.Others 9.DK	
30.	What colour ration card does the client has?	1. White 2. Pink 3. No card 9.DK	

Follow up

Q	Follow up -		48 hr	7 day	28 day
31.	Is the client at the hospital / home? *If, 6 or 7 end here*	1. at the same hospital 2. Referred to other hospital 3. Discharged , at home 4. Was never admitted , at home 5. Re-admitted 6. Death at hospital 7. Death at home *If, 6 or 7, when? dd/mm/yy:* _____			
Refer to Question no. 3- *If option 1,3 or 7 go to 32 and end; If 4, go to 32 and continue; If 2, 5, or 6, skip to 34; If 8, skip to 35*					
32.	How is the medical condition of the client?	1. Improved 2. Same 3. Worsene 4. Can't say			
33.	If 4 in Q3, Is the foetus viable? *If 1 or 2, end here; else continue*	*1.* Yes 0. No 3. Delivered			
34.	How is the condition of the mother post-delivery? *If 1 or 4, skip to 37;* *If 2 or 3, go to 35*	1. Stable 2. Developed complications 3. Critical 4. Died			
35.	What complication did she have?	*Refer the guide for codes of post-delivery complications*			
36.	Did she receive treatment for it?	1.Yes 0.No 9.Don't know			
37.	How did the mother deliver? *If 1, go to 38 ; If 2 or 3, skip to 39*	1. Delivered normally 2. Delivered with instrument assistance 3. Delivered with operation			
38.	If normal delivery, then delivery by?	1. Untrained person at home 2. EMT at home 3. In transit in ambulance by EMT 4. In transit by non 108 service 5. By ANM at home 6. By ANM at Sub center 7. By staff nurse / doctor at home 8. By staff nurse / doctor at hospital			
39.	Did the case complete 8 months of pregnancy before delivering?	1. ≥9 months 2. 8-9 months 3. <8 months			
40.	How is the condition of new born?	1. Stable 2. Developed complications 3. Critical 4. Died after birth 5. Born dead			
41.	Weight of the neonate at birth / at time of follow up?	At birth _____ gm *Enter 99 if Don't know*			

ANNEX XA: CHARACTERISTICS OF PREGNANT WOMEN WHO CALLED '108' IN THE STUDY STATES ('108' TELEPHONE SURVEY)

Table 37: Sociodemographic characteristics of pregnant women who called '108' in the study states ('108' telephone survey)

	Andhra Pradesh			Himachal Pradesh	
Use of ambulance	Transported using ambulance N= 582, %	Ambulance assigned but not used N= 215, %	Ambulance not assigned N= 74, %	Transported using ambulance N= 615, %	Ambulance not assigned N= 111, %
Age					
< 20 years	7.0	6.0	5.4	3.1	8.1
20-24 years	64.1	58.6	66.2	48.1	45.9
25-29 years	23.7	25.6	21.6	36.4	36.0
30-34 years	3.8	7.0	2.7	9.4	6.3
≥ 35 years	0.3	1.9	0.0	2.9	3.6
Don't know	0.5	0.9	4.1	0.0	0.0
Social caste					
Other backward caste	51.4	56.7	55.4	13.8	14.4
Scheduled caste	33.8	25.1	24.3	25.7	27.0
Scheduled tribe	13.9	14.9	13.5	5.7	6.3
General	0.7	2.3	6.8	31.9	30.6
Don't know	0.2	0.9	0.0	22.9	21.6
Economic class					
Below poverty line	93.6	90.2	93.2	15.9	18.9
Above poverty line	0.9	1.4	0.0	49.3	45.0
Don't know	5.5	8.4	6.8	34.8	36.0
Pregnant women worked for earnings during this pregnancy	45.2	47.4	42.3	5.4	8.1
Education status of pregnant women					
Illiterate	38.0	43.7	37.8	9.1	8.1
Primary school	12.2	14.4	20.3	7.5	12.6
Middle school	29.0	21.4	24.3	39.7	42.3
12 grade	9.8	9.3	6.8	27.5	27.9
Graduate or above	6.5	4.2	5.5	11.5	7.2
Don't know	4.5	7.0	5.4	4.8	1.8
Education status of husband of pregnant women					
Illiterate	39.0	43.3	43.2	4.6	6.3
Primary school	11.3	12.6	10.8	7.2	7.2
Middle school	23.2	23.2	28.4	43.4	47.7
12^{th}	5.8	4.2	1.4	29.6	26.1
Graduate or above	12.7	7.5	9.5	9.9	11.7
Don't know	7.9	9.3	6.8	5.4	0.9
Religion					
Hindu	69.1	72.1	70.3	95.3	99.1
Muslim	0.9	2.3	6.8	4.1	0.9
Others	29.9	24.2	23.0	0.5	0.0
Don't know	0.2	1.4	0.0	0.2	0.0
Area					
Rural	84.5	87.4	85.1	94.5	75.7
Tribal	6.5	5.1	2.7	4.2	22.5
Urban	8.9	7.4	12.2	1.3	1.8

ANNEX XB: DETAILS ON HIGH-RISK PREGNANCY, EARLY COMPLICATION IN PREGNANCY AND OBSTETRIC EMERGENCY ('108' TELEPHONE SURVEY)

Table 38: Details on high-risk pregnancy, early complication in pregnancy and obstetric emergency ('108' telephone survey)

	Andhra Pradesh			Himachal Pradesh	
Use of ambulance	Transported using ambulance N= 582, %	Ambulance assigned but not used N= 215, %	Ambulance not assigned N= 74, %	Transported using ambulance N= 615, %	Ambulance not assigned N= 111, %
High-risk in current Pregnancy					
Age < 20	7.0	6.0	5.4	3.1	8.1
Primigravida >35	0.1	0.0	0.0	0.9	2.5
Height < 150 cm	5.2	2.8	1.4	13.5	7.2
≥ 4 pregnancies	3.3	3.3	5.4	0.02	0.0
History of medical illness	0.0	0.0	0.0	3.6	2.8
History of complications in previous pregnancy/ pregnancies (women with gravida 2 or more)					
	N=315, %	N=130, %	N=42, %	N=287, %	N=35, %
Birth by operation over abdomen	16.5	7.1	9.5	13.6	6.5
Obstructed labour	0.7	1.6	0.0	0.0	0.0
High blood pressure	0.0	0.8	0.0	0.0	0.0
Convulsions/ fits	0.0	0.0	0.0	0.0	0.0
High sugar	0.3	0.0	0.0	0.7	0.0
Neonatal death	2.3	3.9	4.8	0.0	0.0
3 or more consecutive abortions/ stillbirths	0.3	0.0	0.0	0.3	0.0
Premature births	1.7	0.0	0.0	0.0	0.0
Multiple pregnancies	0.0	0.0	0.0	0.3	0.0
	N= 582, %	N= 215, %	N= 74, %	N= 615, %	N= 111, %
Any high-risk	22.2	17.7	18.9	27.0	18.9
Early complication in current pregnancy					
Haemoglobin < 7 gm%	13.2	6.5	6.8	9.8	11.7
High BP	2.1	2.8	1.4	2.4	0.9
Convulsions/ fits	0.3	0.0	0.0	0.0	0.9
High sugar	0.3	0.0	0.0	0.5	0.0
Bleeding from vagina	0.9	0.0	0.0	1.0	0.9
High fever	0.5	0.0	0.0	4.1	1.8
Foul smelling discharge from vagina	0.3	0.0	0.0	0.5	0.9
Others	0.2	0.0	0.0	1.8	0.0
Any early complication	16.2	8.4	8.1	15.9	16.0
Obstetric emergency in pregnancy or delivery or post-delivery					
Obstetric emergency in pregnancy					
Bleeding in pregnancy	1.0	0.9	0.0	0.0	0.0
High fever	0.7	0.7	0.0	0.3	0.0
Ectopic pregnancy/rupture	0.7	0.9	0.0	0.0	0.0
High BP/ convulsions	0.5	0.0	0.0	0.2	0.0
Foul smelling discharge	0.5	0.0	0.0	0.7	0.9
Foetal distress	0.5	0.7	0.0	0.0	0.0
Excessive vomiting	0.0	0.0	0.0	0.7	0.0
Obstetric emergency during delivery					
Preterm labour	2.1	4.2	0.2	0.2	0.0
Moderate to Severe anaemia	1.5	0.5	0.0	0.0	0.0
Excessive bleeding	1.0	1.4	0.0	5.0	4.5
High BP/ convulsions	0.9	3.3	1.4	1.3	0.0
High fever	0.0	0.0	0.0	0.8	0.0
Multiple foetus/ Malpresentation	0.2	0.5	0.0	0.2	0.0
Others	0.7	0.9	0.0	0.2	0.0
Any obstetric emergency at time of call	7.4	9.8	4.1	9.3	5.4